

**THE VALUE OF PUBLIC TRANSPORTATION FOR IMPROVING THE
QUALITY OF LIFE FOR THE RURAL ELDERLY**

A Thesis

by

ALICIA ANN ISRAEL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2012

Major Subject: Agricultural Economics

The Value of Public Transportation for Improving the
Quality of Life for the Rural Elderly
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May 2012

Major Subject: Agricultural Economics

ABSTRACT

The Value of Public Transportation for Improving the
Quality of Life for the Rural Elderly. (May 2012)

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Co-Chairs of Advisory Committee: Dr. James W. Mjelde
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Mobility is an undeniable issue for current and future elderly populations. The increasing popularity for retirees to live in rural communities makes this a particularly important issue in rural towns. When an elderly individual living in a rural community is no longer able to drive, issues that come with living in a rural area may be exacerbated, and the individual may experience a decrease in their quality of life. Although individuals may be able to use public transportation most existing options do not promote an independent lifestyle.

Any updated rural transportation system benefiting the elderly would be funded by taxpayers. An understanding of the taxpayers' preferences and willingness-to-pay (WTP) for transportation options, therefore, is essential. Few, if any economic studies have addressed this issue. The objectives of this research are to: (1) estimate economic willingness-to-pay (WTP) for public transportation options by using choice modeling techniques; and (2) better understand opinions related to public transportation for the elderly held by the general population as a whole and within different demographics. To complete these objectives, a choice survey was distributed to samples of three

populations: residents of Atascosa County (located in south Texas); residents of Polk County (located in east Texas); and students at Texas A&M University. Respondents were presented with transportation options made of five attributes: addition to annual vehicle registration fee, days of operation, hours of operation, type of route, and senior citizen transportation fare discount.

Results show both students and the general public value public transportation options and are willing to pay for specific transportation attributes. Respondents tended to prefer options which are more flexible than the less flexible attribute presented to them; however, respondents did not necessarily prefer the most flexible options. Students, generally, are willing to pay more for transportation attributes than county residents. Overall, both Atascosa and Polk County residents have similar WTP's, indicating both populations value rural public transportation similarly. The effects of socio-demographic variables on residents' decision to choose a transportation option appear to differ between the counties. These findings imply that while the influence of transportation attribute levels are consistent across counties, local input is important in customizing transportation systems to meet local expectations.

DEDICATION

I would like to dedicate my thesis to John Israel, Jeanne Israel, and Zane Schwarzlose. I would not be where I am today without your patience, love, and support.

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I would like to express heart-felt gratitude to my committee co-chair, Dr. James Mjelde, for supporting me throughout this entire research project. I want to thank him for believing in my abilities and giving me this unique research opportunity. I came to graduate school hoping to challenge myself above and beyond my previous academic endeavors; because of him I have been able to do just that. His research experience and guidance has been invaluable to me throughout this process. I am especially thankful for his patience while editing this manuscript. I will be forever thankful for his presence throughout my graduate education.

Next, I would like to thank those involved with me in this research project: my committee co-chair Dr. Rebekka Dudensing, Dr. Yanhong Jin, Linda Cherrington, and Linda Parker. From writing proposals, creating the survey questionnaires, building the statistical models, to teaching me the ins and outs of rural public transportation; I could not have completed this research without their help and expertise. Thanks also go to my committee members, Dr. Kerry Litzenberg and Dr. Katherine Turnbull for their encouragement of this project.

I also would like acknowledge the Texas Transportation Institute for supporting this research. Without the financial assistance of TTI, we could not have completed these surveys. I would also like to thank everyone who contributed to the county and student surveys: Judge John P. Thompson, of Polk County; Judge Diana Bautista, of Atascosa County; Dr. Ariun Ishdorj; Dr. Kerry Litzenberg; and all of the county and

student participants. I also would like to acknowledge Junyi Chen for her help and constant dedication in putting together every single one of the county questionnaires.

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CHAPTER I

INTRODUCTION AND RESEARCH OBJECTIVES

Texas has one of the largest elderly¹ populations in the country (He et al. 2005); this population is expected to increase in the coming decades (Texas State Demographer 2008). In 2009, nearly 25% of Texans over the age of 65 lived in rural areas (U.S. Census Bureau 2009). Living in rural towns or in the countryside will continue to be popular among current and future elderly cohorts (Cromartie and Nelson 2009). It, therefore, is necessary for Texas' rural community developers to consider this age group when planning for the future, especially because maintaining a high quality of life can be challenging for residents of rural communities. Specifically, transportation issues are consistently mentioned by researchers as integral to the quality of life for rural senior citizens (Glasgow and Blakely 2000; Grant and Rice 1983).

Although driving a private vehicle well into retirement is popular among rural Texans, studies have shown that this is not always the most feasible or safest option for elderly individuals (Burns 1999; Glasgow and Blakely 2000; Rosenbloom 2004, 2009). There are limited rural public transportation options in Texas. The options that do exist, generally, do not promote an independent lifestyle if used as a primary form of transportation for daily activities (Foster et al. 1996; Glasgow and Blakely 2000; Mattson 2011; Rosenbloom 2004, 2009). An elderly individual living in the country or a

This thesis follows the style of *The American Journal of Agricultural Economics*.

¹ In this thesis, the terms 'elderly,' 'senior citizens,' 'elderly population,' 'elderly cohort,' etc. refer to those who are 65 years of age or older.

rural community who loses the ability to drive, therefore, might suffer from isolation and a lower quality of life. Public transportation which supports elderly individuals is an important issue for rural developers to consider in creating an aging friendly community.

Objectives

This research estimates the willingness-to-pay of Texas county residents and students for transportation options which support the rural elderly. An updated rural transportation system would most likely need to be funded by taxpayers, so an understanding of their preferences and willingness-to-pay for transportation options is essential. The objectives of this research are: (1) estimate economic willingness-to-pay (WTP) for various public transportation options by using choice modeling techniques, namely, conditional and mixed logit estimation; and (2) better understand opinions related to public transportation for the elderly held by the general population as a whole and within different demographics. Specific questions which will be addressed, but are not limited to the following: Would a taxpayer be willing to pay for transportation services? Do older individuals prefer different transportation options more than younger individuals? Would those who have children living far away from their home be willing to pay more than those whose children live close to their home? To complete these objectives, Texas county residents and students are surveyed. Using both of these groups is important because an updated rural transportation system would affect county residents sooner than students, but undergraduate students will pay for this update longer than many current county residents. By meeting these objectives, a better understanding of who would be

willing to pay and how much they are willing to pay for which type of transportation options is obtained.

This research contributes to the current literature on elderly mobility by addressing non-emergency mobility issues. Previous studies have focused on the general or metropolitan elderly population and the availability of medical transportation. Transportation for medical reasons, however, is generally more accessible for senior citizens than transportation to go shopping or attend community and social functions. Although medical transportation is not to be excluded from this research, the focus is on transportation options which support the non-medical needs of the elderly.

CHAPTER II

LITERATURE REVIEW

Background - Elderly Population of the U.S. and Texas

The high birth rates sustained by the economic prosperity and family-friendly government programs immediately following WWII gave rise to the Baby Boomers, one of the largest generations in U.S. history (U.S. Census Bureau 2006). Demographics in the U.S. are showing the effects of the Baby Boomer cohort. For example in 1990, just before Baby Boomers began to reach middle-age, only 42 million people or 17% of the population were in their middle-age years (Cromartie and Nelson 2009). By 2009, there were 83 million Baby Boomers between the ages of 45 and 63, approximately 28% of the U.S. population (Cromartie and Nelson 2009). Because this cohort represents a large, diverse portion of the U.S. population, Baby Boomers have been the subject of considerable research as they have matured (Rosenbloom 1993; U.S. Department of Agriculture 2007). As Baby Boomers have reached retirement age, research has turned to determining how current social programs may need to be adjusted to accommodate this population cohort (Alsnih and Hensher 2003; Cromartie and Nelson 2009; U.S. Department of Agriculture 2007).

Elderly Population

The elderly population is increasing and will continue to do so as Baby Boomers age and the elderly live longer, healthier lives (He et al. 2005; Rosenbloom 2004). In 2009, 39.6 million Americans, or 12.9% of the total population, were over age 65, with

approximately 5.6 million (1.8%) over age 85 (U.S. Census Bureau 2009). The U.S. Census Bureau (2008) projected that the elderly cohort will increase to approximately 55 million by 2020. Rosenbloom (2004, p. 2) states,

Most of the elderly will be in good health and not seriously disabled. In fact disability rates have been falling among all cohorts of the elderly for decades, owing to a combination of good nutrition, improved health care, better education and higher incomes...Although disability rates increase with age, two-thirds of those over age 85 reported being in good to excellent health. Overall, new generations of older Americans will be healthier for a greater percentage of their lives than those just a few decades ago.

Because today's elderly are healthier than in the past, they have a greater ability to be engaged in community activities throughout their lives. Since the elderly are living longer, to sustain an active life and remain independent, they may be more likely to need mobility assistance at some point in their life (He et al. 2005; Rosenbloom 2004).²

Demographics of the Texas Elderly

Between 1970 and 2009, the population of the Texas elderly grew in absolute and relative numbers compared to the rest of the population. In 1970, this cohort comprised 8% of the population, a little over 993,000 people. By 2009 the number of people over the age of 65 grew to about 2,500,000, approximately 10% of the total Texas population (U.S. Census Bureau 1986, 1993, 2000a, 2009). Compared to the rest of the United States, in 2009 Texas had the fourth largest elderly population (He et al. 2005). The Texas State Demographer (2008) projects that there will be 3.7 million people over the age of 65 living in Texas by the year 2020, a 51% increase from 2010. The historical

² There are authors who predict life expectancies will decrease because of obesity and other health issues. For examples of these opinions, see to Exatti et al. (2008), Murray et al. (2006), and Olshansky et al. (2005).

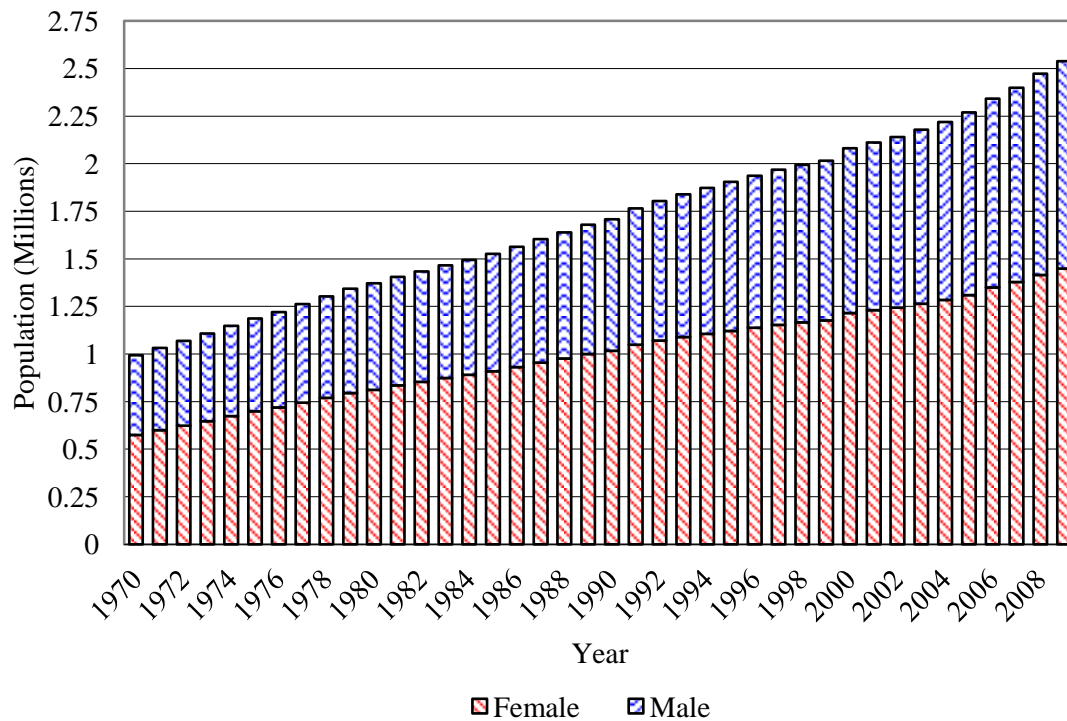


Figure 1. Distribution of Texas Elderly Population by Gender

break down of the elderly population by gender is shown in Figure 1. Females make up about 60% of the cohort, consistently outnumbering males (Figure 1).

As stated previously, a larger share of the U.S. elderly are living past the age of 85. This trend is consistent in Texas. Although all age groups within the Texas elderly cohort are growing (Figure 2), the percentage of those aged 65-75 has decreased, while the percentage of people over the age of 80 has increased relative to the entire elderly cohort (Figure 3). Texans over the age of 85 have grown from 7% of the elderly population in 1970 to 13% in 2009 (Figure 3).

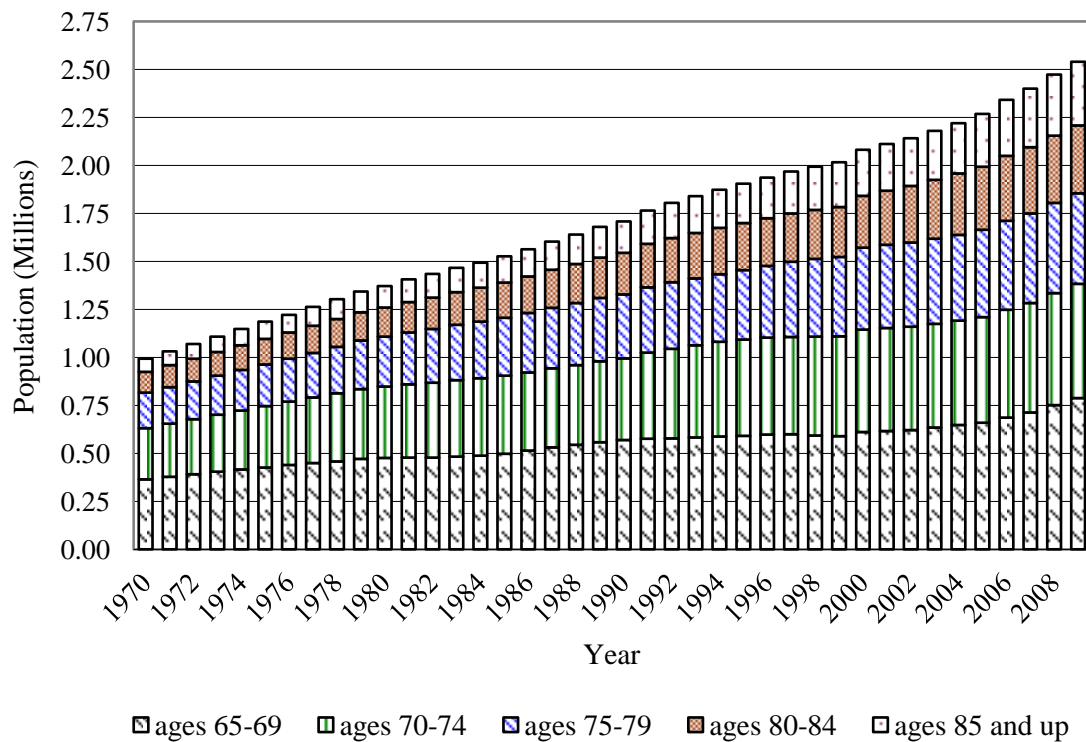


Figure 2. Distribution of Texas Elderly by Age Grouping

Residency Trends

In the future, elderly Americans will become an increasingly important cohort in rural regions. In 2009, nonmetro areas contained 23% of the elderly population in the United States (U.S. Census Bureau 2010a). Cromartie and Nelson (2009) state a 30% growth rate is expected for people aged 55-75 in rural and small-town areas through 2020, which would result in an increase from 8.6 million in 2000 to 14 million people living in these areas. Three processes are contributing to the aging of these nonmetro areas: (1) migration of older Americans to rural areas; (2) aging-in-place phenomenon; and (3)

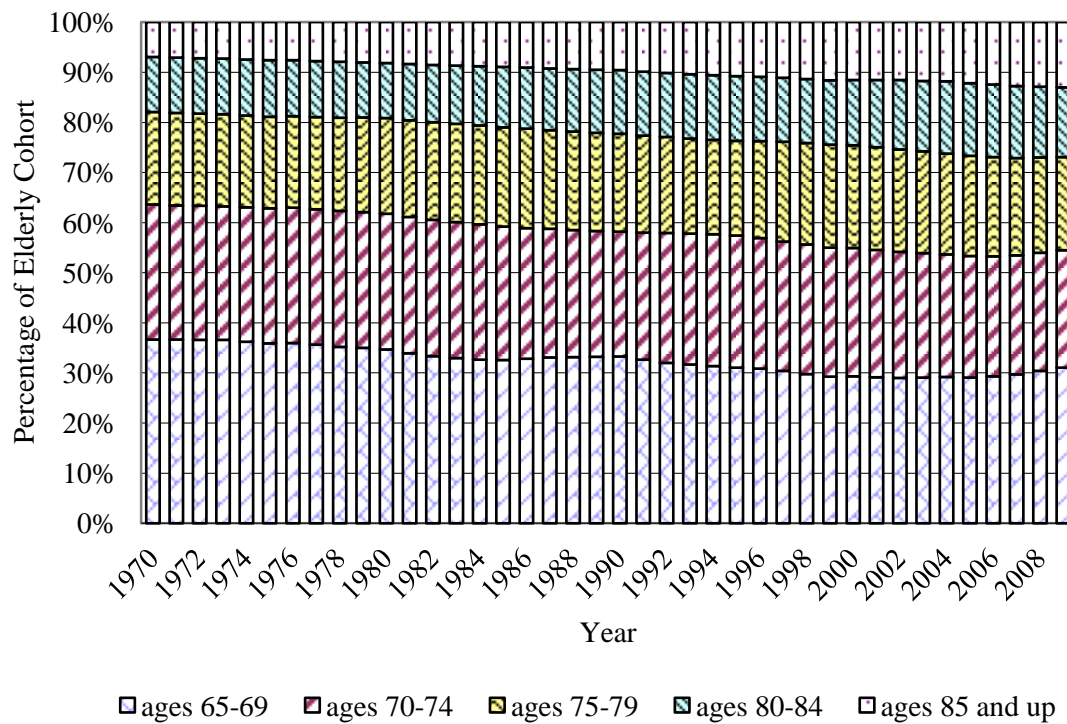


Figure 3. Percentage of Each Age Group among the Elderly Cohort

outmigration of younger Americans to urban areas (Rosenbloom 2004; U.S. Department of Agriculture 2007).

Migration. The Baby Boomer cohort is showing a tendency to move to rural areas both before and after retirement age. Migration was popular among empty nesters of the 1990's with the economic boom of the dot.com era providing the financial means to relocate (Cromartie 2006; Cromartie and Nelson 2009; Nelson, Nicholson, and Stege 2004). The number of retired Baby Boomers migrating to rural areas is also increasing (Nelson, Nicholson, and Stege 2004; U.S. Department of Agriculture 2007). Cromartie and Nelson (2009, p. III) note,

In this decade and the next, this [Baby Boom] cohort will pass through stages when moves to nonmetro counties increase, especially to areas with scenic and urban amenities, high second-home concentrations, and lower housing costs...Baby Boomers have already demonstrated more of an affinity for moving to rural and small-town destinations than older or younger cohorts.

Cromartie and Nelson (2009) predict that migration among empty nesters and retirees will increase from 277,000 migrants in the 1990's to 383,000 in the 2010's. Nonmetro counties will see the largest increase migration. Baby Boomers migrating to rural areas tend to be better educated, wealthier, and less likely to be living alone than those in the same age cohort that are aging-in-place in rural areas (Frey 1999; U.S. Department of Agriculture 2007).

Aging-in-place. The aging-in-place phenomenon is characterized by retirees who have remained in the homes in which they raised their children and built their career (Alsnih and Hensher 2003; Lin 1999; Rosenbloom 2004; Skinner and Stearns 1999). The growth of the aging-in-place elderly is expected to triple among the older rural population, from 6% in the 2000's to 18% in the 2010's (U.S. Department of Agriculture 2007). As noted earlier, rural elderly aging-in-place tend to be less financially well off than their counterparts immigrating to rural areas; they generally have lower incomes, lower educational attainment, and a higher dependence on social security income (U.S. Department of Agriculture 2007).

Outmigration. Aging-in-place along with increased migration rates has led to an absolute growth in the rural elderly population; however, also contributing to the relative population increase is the outmigration of younger people from nonmetro areas. "In almost all settings, the propensity to migrate is highest among individuals ages 20-30

and rural to urban migration among young adults always outnumbers its counter stream” (U.S. Department of Agriculture 2007, p. 2). Cromartie and Nelson (2009) assert that without the younger generation’s outmigration from rural areas, the rate of percentage growth in these areas between 2010 and 2020 for those aged 65 and older would be cut nearly in half.

Mobility and the Elderly

Numerous factors contribute to the quality of life for both the elderly and nonelderly. Acknowledging the importance of all these issues, the following literature review concentrates on one factor, transportation issues which affect mobility. Further, this review only tangentially addresses the important issue of medical transportation for the elderly. This is not to down play the importance of this issue, but many studies on medical transportation exist. For a discussion of the issues related to medical transportation see Arcury et al. (2005), Mattson (2010), Wallace, Hughes-Cromwick, and Mull (2006), and Wallace et al. (2005).

Mobility is defined as a person’s ability to travel (Robson 1982) or the freedom, independence, and convenience of movement for non-medical activities (Burns 1999). As suggested in the demographic section, mobility of the growing elderly population will become an increasingly important public policy issue. By far, the majority of previous studies have addressed elderly mobility from a sociological perspective using surveys which are usually limited to responses from elderly individuals. Few if any, studies have addressed the problem from the perspective of the general public’s opinions of or willingness-to-pay for services that enhance the mobility of the elderly.

Burns (1999) states that well-being is dependent upon the fulfillment of one's needs. Mobility and the availability of transportation contribute to this fulfillment by helping one meet medical, social, and personal needs. In general, because the rural elderly are more isolated and usually live at a greater distance from medical and other services than their urban counterparts, transportation options are central to meeting the requirements of the rural elderly (Glasgow and Blakely 2000; Revis 1971). Grant and Rice (1983), however, report that 18.5% of the rural elderly have a serious problem with transportation to almost all destinations. Within the American lifestyle, there is no question of the importance of transportation to the quality of life of people of all ages. Transportation services, however, may become limited as people age.

Car Usage by the Elderly

Rosenbloom (2004, p. 4) states, "Regardless of where they live, most older people are extremely dependent on the private car." Because the private automobile has become the most popular form of transportation in today's culture, today's elderly have become accustomed to the uses and convenience of a car; pre-retirement and during retirement the car remains the most efficient manner to fulfill most every day mobility needs (Alsnih and Hensher 2003). In rural households, automobile ownership is more prevalent than among urban households because of the relatively longer distances to travel to services and lack of alternative transportation options (Brown 2008; Gombeski and Smolensky 1980; McGhee 1983).

Licensing rates are expected to grow for the elderly. In 1997, more than 95% of men and 80% of women over the age of 65 were licensed to drive (Rosenbloom 2004).

As Baby Boomers age, the gap between men and women licensed drivers will, most likely, narrow. Evidence of this potential shrinking gap is seen in that 94% of women aged 45-49 were licensed to drive in 2009 (Rosenbloom 2004).

Concerns Associated with Driving. Driving, although the most convenient mode of transportation, has its own set of benefits and concerns. The most obvious benefit is the freedom of mobility associated with driving oneself. This freedom motivates the elderly to continue driving even when driving becomes a difficult task (Burns 1999). Elderly drivers note that as they age they suffer from handicaps which cause them to have trouble driving (Glasgow and Blakely 2000). To compensate for age related disabilities, the elderly may limit their driving behavior. Because of poorer night vision and problems with headlight glare, for example, many elderly drivers avoid driving at nighttime or on poorly lit roads (British Automobile Association 1988; Rosenbloom 2004, 2009). In addition to night driving, rush hours, turning across traffic, city centers, highways, long trips, bad weather, and unfamiliar routes are cited as driving situations the elderly frequently avoid (British Automobile Association 1988; Burns 1999).

Further, safety is a concern for older drivers. The elderly are more likely to experience a crash per trip or mile driven and are more likely to be at fault, killed or injured in a multicar crash than younger aged drivers (Dellinger, Langlois, and Li 2002). For example in 1997, the fatality rate for drivers 85 and over was nine times as high as the rate for drivers 25 through 69 years old (National Highway Traffic Administration 1999). In 2000, people who were 65 and older had the second highest death rate from motor vehicle accidents (He et al. 2005).

Although more elderly are licensed to drive and dependent on their personal vehicle than previous generations, they may eventually have to stop driving. Some stop because of family or society pressures, but others cite age-related disabilities and health problems as reasons they stopped driving (Glasgow and Blakely 2000). Because people are living longer, an increasing percentage of the elderly will face disabilities (He et al. 2005; Rosenbloom 2004). In 1997, almost 35% of individuals over age 80 reported that their disabilities were severe enough to require assistance (Rosenbloom 2004).

Furthermore, because of fixed and limited incomes, the elderly may not be able to afford the ownership costs of automobiles, payments, insurance, and maintenance, even if disabilities are not an issue (Gombeski and Smolensky 1980). The cost of ownership may be a particular problem for older women and minorities because these groups have higher poverty rates than older Anglo males (Rosenbloom 2004).

Alternative Transportation Options

At some point in their life, disabilities, monetary issues, or other reasons may cause an older person to depend on services other than their personal automobile for mobility.

Those living in rural communities are often at a greater disadvantage than older urban residents because non-metropolitan areas usually have more limited public transportation and/or private taxi services than metropolitan areas. Further as previously noted, rural persons generally live relatively greater distances from services and amenities in their community than urbanites (Talbot 1985). Options most frequently used by the elderly to overcome no longer being able to drive are: rides from family and neighbors, walking,

and public transportation (Glasgow and Blakely 2000; Gombeski and Smolensky 1980; Rosenbloom 2004, 2009).

Rides from Family, and Neighbors. As age increases, there is a tendency to become more dependent on others for transportation (Gombeski and Smolensky 1980). Some elderly, however, do not ask for rides because they do not want to burden their friends or family with driving them to do personal errands. As such, their mobility needs are not always fulfilled; this is especially true for non-medical trips (Glasgow and Blakely 2000).

Older individuals who do not drive are often reliant on friends who are of similar age. Two reasons, often cited in the literature, for relying on older friends are that family members do not live nearby or they are limited by work schedules (Glasgow and Blakely 2000). As noted earlier, children are less likely to live near their rural elderly parents because of the popularity of outmigration from rural areas among younger people. Second, even if living in the area, younger people may not be able to help with daily errands because of work schedules. Because of these reasons, asking neighbors or friends of the same age for rides is often easier than asking younger family members (Glasgow and Blakely 2000). If the friend/neighbor driver is also elderly, asking for rides can often pose the same risks as if the original older person was driving. Furthermore, at some point the older friend may lose the ability to drive. If one or more people depend on this person for transportation, not being able to drive reduces the mobility of several elderly individuals (Rosenbloom 1993).

Walking. Walking, behind car travel, is the second most popular travel mode for older people in the U.S. (Rosenbloom 2004). Urban and rural individuals over the age of 65 walk to a trip destination about 9% of the time, this percentage increases to one out of every four trips if they do not drive (Sweeney 2004). Complaints noted by older pedestrians, include the lack of sidewalks or system of connected sidewalks, upkeep, obstruction problems, and safety concerns (Rosenbloom 2009, Rosenbloom and Herbel 2009). These complaints are undoubtedly compounded in rural areas where activity locations are often too distant to feasibly reach by walking (Glasgow and Blakely 2000).

Private and Public Transportation Alternatives. Transportation alternatives, such as private taxi services, public buses, and Americans with Disabilities Act (ADA) paratransit services are available to the elderly. These forms, however, are not often used among older Americans (Kim and Ulfarsson 2004; Rosenbloom 2004, 2009; Glasgow and Blakely 2000). In fact, the use of these modes of transportation by the elderly has been decreasing. In 1995, the elderly made 2.2% of all trips by transit; this percentage has fallen by almost 50% between 1995 and 2001 (Pucher and Renee 2003). Although the reasons for this drop are not explicitly explained, implicit reasons for the unpopularity of these transportation alternatives described in the literature are outlined below.

Taxi Use. Private taxi services are often nonexistent in rural areas because riders and destinations are often so widely dispersed that the cost of operating these services is high (Grant and Rice 1983; McGhee 1983). Even if available, elderly individuals note that private transportation services are often too expensive for them to use (Glasgow and

Blakely 2000). Because private transit services are not available, the option left for rural individuals is to use public transit services; in rural areas these services are also often limited (Glasgow and Blakely 2000; Grant and Rice 1983; Mattson 2011).

Rural Public Transportation. Rural public transportation is typically demand response transit and requires advance reservation, usually at least 24-hours in advance. The level of service depends on available resources. The rural American transit system, generally, is not adequate compared to the services provided in urban areas (Brown and Stommes 2004; Stommes and Brown 2002). In 2009, 77% of rural American counties recorded some type of public transportation in their community (Transit Cooperative Research Program 2009b). Few of these transit systems are found in the most rural and isolated areas; the majority of these systems are county-based, followed by the multi-county level, and then by the municipal level (Transit Cooperative Research Program 2009a). Rural public transportation access and options have come under scrutiny over the past 30 years, especially in poorer nonmetro communities which have large concentrations of the elderly and disabled (Brown 2008). Although strides have been made to improve rural public transportation, rising costs and limited funding continue to hinder the growth of these programs (Transit Cooperative Research Program 2009b). Studies indicate that both transportation professionals and the elderly feel the public transportation service does not adequately assist older rural residents (Brown and Stommes 2004; Foster et al. 1996).

ADA Complementary Paratransit Services. ADA paratransit is a required complementary service for people with disabilities in areas where there is fixed route

transit³. The majority of rural public transportation options do not include fixed routes; ADA paratransit services, therefore, are often not available in rural areas (Rosenbloom 2004). Services provided by ADA paratransit may fail to assist elderly citizens who are unable to drive or cannot use conventional public transportation (Rosenbloom 2004, 2009).

Additionally, even if access to ADA paratransit services is available to an elderly individual, he/she may not be qualified to use them. Rosenbloom (2009, p 34) states,

Indeed, the vast number of older people in the United States do not and probably will not live in or travel in neighborhoods with ADA paratransit service, and, even if they do live or travel in such corridors, they are unlikely to qualify for those services for most of their lives after they reach age 65.

Eligibility for ADA services is based on disability and not age; therefore, having minor age related handicaps or being unable to drive does not necessarily qualify an individual for ADA paratransit. For example, in 2009, 42% of elderly people with at least one disability were not eligible for these services because their impairments were not serious enough to meet ADA eligibility requirements (Rosenbloom 2009).

Public Transportation and Travel Independence. Even if an elderly individual has access to public transit (public bus, ADA paratransit, etc.), these services may not provide the means to be an independent traveler. Elderly individuals indicate that public transportation schedules do not allow them flexibility when making trip plans, because they often must schedule a trip in advance and are confined to time and route limitations of the transit schedules (Foster et al. 1996; Glasgow and Blakely 2000; Mattson 2011;

³ Fixed route transit refers to transit that operates along a specific defined route. Passengers board and exit at designated stops along the route according to a preset schedule.

Rosenbloom 2004, 2009). Rural transit systems in particular often stop at the county line. By the way the transportation system is structured, an individual traveling cannot expect to connect seamlessly to another county-based transit system or intercity bus service (Stommes and Brown 2002). Even non-profit community groups that provide client transit services are not always flexible. They often limit travel to destinations deemed essential, such as medical appointments, even though these trips make up no more than 5% of the total trips that older people take (Rosenbloom 2009).

Public Transportation in Rural Texas

Public transportation in Texas is provided by 38 rural transit districts, 30 urban transit systems, and nine metropolitan transit authorities or departments. A rural transit district serves non-urbanized areas with populations of less than 50,000 and is required by Texas statute to provide and coordinate rural public transportation in its rural territory. In 2010, elderly Texans represented an estimated 34% of the population in rural transit districts as compared to 24% of the total Texas population (Eschbach et al. 2010). The elderly population is expected to increase in 30 of the 38 rural transit districts, which suggests that demand for rural public transportation will increase (Eschbach et al. 2010). Because of this increasing demand, current transportation services may need to be restructured to reflect the preferences of this population. The current national and state level budget crunches, however, have caused per capita investment in Texas transportation services to decline (Eschbach et al. 2010). Without new funding there most likely will be a reallocation of funds to assist transit in areas with the largest total population growth (metropolitan areas and counties along the Texas-Mexico border),

which means there may not be sufficient funds for new or restructured transit services in rural areas (Eschbach et al. 2010).

Quality of Life Implications

Although there are advantages associated with living in a rural area, the well being of older rural residents may suffer from several disadvantages unique to these areas. The variety of and access to health care and other personal services is more limited in rural areas; attracting doctors, nurses, and other service professionals is difficult where per capita costs are higher, the population is sparse, and the area is more isolated (Mattson 2011; U.S. Department of Agriculture 2007). Previous literature indicates the elderly receive a substantial amount of support from their children and relatives to overcome these barriers (Grant and Rice 1983; Gombeski and Smolensky 1980; McGhee 1983). This support, however, may not be available as younger generations become more career oriented, move farther away from their aging parents, and family size decreases (Glasgow and Blakely 2000; Putnam 1995; U.S. Department of Agriculture 2007). When an elderly individual is no longer able to drive, without support, these issues can be exaggerated and the individual may experience a decrease in their quality of life.

Inadequate transportation arrangements have been cited as a significant contributor to lower life satisfaction, morale, and health. Glasgow and Blakely (2000) find that loneliness was a cited problem among nonmetropolitan older residents. A participant in Glasgow and Blakely (2000, p. 113) is quoted as saying,

Don't you think the biggest share of the senior citizens' problems is loneliness? You know. They don't have families. They get older and older and older each day. They get so confined to their homes. Whereas, if they got a bus they know

is there, they are going to help them on the bus and sit down, and off the bus very safely. There would be more people who would go out.

This loneliness and lack of participation in the community is detrimental to the emotional and physical health of older individuals (Glasgow and Blakely 2000).

Inadequate transportation options also reduce older adults' ability to participate in the economy. Non-drivers who are 65 and over make less than half as many shopping trips and trips to restaurants and other places to eat as drivers do (Bailey 2004). Bailey (2004) concludes that elderly who live in the West South Central states of the U.S. (this area includes Texas) experience a high amount of isolation because of the limited transportation options provided in this area. With the percentage of the elderly rural population growing and the younger rural population diminishing, the elderly are left to depend more on themselves, people of the same age, their community, and government services for their well-being (Alsnih and Hensher 2003; Gombeski and Smolensky 1980; Grant and Rice 1983; Kim and Ulfarsson 2004; McGhee 1983; Rosenbloom 2004, 2009).

CHAPTER III

METHODOLOGY AND SURVEY DESIGN

To achieve the study's research objectives, a choice survey was created and distributed to Texas A&M University undergraduate students and residents of Atascosa and Polk counties, Texas. The choice survey format provides a tool to obtain economic willingness-to-pay for various transportation options. By surveying both students and county residents, comparisons between opinions of different age/socio-demographic groups can be made. The random utility model provides the basis for econometric models that will be estimated using conditional and mixed logit estimation.

Questionnaire Design

Two similar questionnaires are created, one for the student sample, and the other for the county resident sample. Both questionnaires contained similar questions which were based on previous surveys, the literature, and expert opinions. Two focus groups were held to refine the student survey instrument. An additional focus group and professional editor from the Texas Transportation Institute provided comments on the county resident questionnaire. Before distribution, approval for the study was obtained by the Texas A&M University Institutional Review Board. Final survey instruments used in the student and county resident surveys are in Appendices C and D.

Focus Groups - Students

Two focus groups of students enrolled at Texas A&M University – College Station were conducted. The first focus group met on April 4, 2011 at 1 PM, whereas, the second met

on April 11, 2011 at 10 AM. Participants in the first focus group consisted of six graduate students; four were enrolled in the Department of Agricultural Economics, one in the Department of Oceanography, and one in the Department of Computer Science. This focus group consisted of three males and three females. Their hometowns were located in Texas, Kansas, California, Canada, and Morocco. Five of the participants' homes were located within the city limits and one was located outside the city limits on a farm. The focus group organization was a free flowing but directed discussion. In particular, the discussion was directed towards three main topics: questionnaire length, question wording and formatting, and factors which would influence their decisions.

The first focus group unanimously agreed that the questionnaire was too lengthy. They commented that some questions and sections were too wordy, which made the respondent lose focus. It took the focus group members between 10 and 15 minutes to complete the questionnaire. Further, the group noted some questions concerning the respondents' hometown (i.e. the distance the respondent lives from his/her parents) may be hard to answer given the respondent's parent's marital status. Questions to identify the respondents' familiarity with elderly transportation issues were worded too similarly; therefore, making them difficult to answer. The largest fee that anyone in the focus group would be willing to pay for any of the transportation options was \$30. The majority of participants thought that the days and hours the transportation option would be in service were important attributes. It was noted that the actual days and hours (i.e. seven days a week from 8AM to 5PM) of operation would be more important in making a decision than just the number of days and hours (i.e. three days a week for 8 hours a

day). Some participants believed that although more hours and days were better, individuals could adjust their schedules to limited days and hours in operation. The range of service area was also important to the focus group; but they were confused on how to interpret the size of the service area. The participants thought a fare discount for senior citizens was important, but they thought it was the least important factor in making a decision. Given an original fare of \$2.00, the participants thought that any discount would be inconsequential given the original fare was already low. Overall, the participants of the first focus group preferred transportation attributes which were the most flexible and accommodating of senior citizens. They, however, had trouble interpreting the levels of transportation attributes.

After revising the questionnaire, a second focus group was conducted. This group consisted of four graduate students enrolled in the Department of Statistics and two undergraduate students enrolled in the Department of Mathematics and Biochemistry/Genetics. One of the student's home towns was located in North Carolina, whereas, the other five were located in Texas. Two of the student's homes were located inside their hometown's city limits; the other four were located on the boundary of the city limits. The organization was similar to the first focus group, focusing on the same topics.

Although the length of the questionnaire was still an issue with this focus group, this version took the participants considerably less time to complete; all finished within eight to ten minutes. Most of the previous issues with the original questionnaire seemed to be addressed. The focus group, however, had trouble when ranking their familiarity

of their hometown's public transportation options. Most did not know if any public transit existed in their hometown, hence answering "not at all familiar" was not necessarily a true observation. It was suggested to add a question addressing whether or not the respondent is aware of transportation options in their hometown. The questions used to identify the respondents' familiarity with elderly transportation issues were again, difficult to answer. One of the participants noted that it was not clear how to include deceased family members when answering the question. Also, it was difficult to distinguish between a "do not know" and a "no" answer. This focus group's opinions about the transportation attributes were similar to the first focus group. Flexible days and hours of operation were extremely important. The range of service was important, however, further clarification of the levels of this attribute would be preferred. This focus group had mixed opinions on the importance of the fare discount. Those who supported or were against a discount had very strong opinions in either case. Overall, however, this attribute was least important in the focus group's decision making process.

Focus Group - County Residents

After revising the questionnaire and adding county specific questions, a focus group of Atascosa County residents was conducted on July 21 at 6 PM in the Pleasanton, Texas City Hall. This focus group included seven people who resided in Atascosa County. Six lived in Pleasanton and one lived in the town of Jourdanton. The focus group included three males and four females. Format of the issues presented to the group followed a similar procedure as the previous two focus groups. The main issue presented to the focus group was to consider the audience of people who would be filling out the

questionnaire; they suggested some clarification of the questions and introductions would be necessary. For example, in answering a question which mentioned the respondent's dependents, one of the participants was confused as to who to consider as "dependents." He considered his wife a dependent; as such he was not clear how to answer the question. The group suggested changing the phrase from "children or dependents" to "children or dependents, excluding your spouse." One of the participants mentioned that she had more than one mailing address within the county. She suggested that we use the phrase "primary mailing address" to clarify the question.

All participants were unsure of how to answer whether or not they knew about the Alamo Regional Transit (ART) options in the county. Most had seen ART vehicles, but had no idea what they did or who could use them. They, therefore, could not answer yes to the question because it asked if the respondent was, "Aware of the public transportation options provided by ART." The objective of that question is determine if the respondent knew of ART, then a following series of questions were included to give an idea if the respondent knew the details about ART's public transit options. The focus group agreed that by leaving 'options' out of the first question it would be easier to respond correctly. Other suggestions from the focus group included: shortening the content included in the introduction to the choice questions; further clarification of the hypothetical nature of the survey; and highlight the statement "Please consider each of the following six scenarios independently" so there is no confusion on how to fill out the choice questions. Participants of this focus group felt that all transportation attributes were important in their decision making process. Although the definitions of the

attributes were lengthy, each respondent felt they clearly understood the levels of each attribute. Again, the questionnaire was revised based on the focus groups comments.

Survey Questionnaire Design

The questionnaire contained a series of questions to provide background information on the respondent. These questions included common demographic inquiries like age, sex, race, and income. Some demographic questions were specific to the student or county resident questionnaires. To determine income, for instance, county residents were directly asked for their before-tax income. Students, however, were asked what percentage of their funding for school came from which various sources (parents, self, scholarship, military, etc.). County residents, also, were asked how far away each of their dependents lived from the resident's home. All respondents were asked questions about their knowledge of and opinions about local public transit opportunities. Finally, respondents were asked to provide their subjective probability that they would live to be over 75, live in rural community, and need assistance with transportation. These inquiries into respondents' subjective probabilities were designed similarly to questions asked by the Institute for Social Research (2010).

Choice Scenario Design. One critical part of the survey is the choice experiment design. The Choice Experiment, which is in the family of choice modeling approaches, provides a useful methodology to obtain welfare consistent estimation for evaluating the monetary value of different attributes (Hanley, Mourato, and Wright 2001). In this type of study, respondents are presented with two or more alternatives, where each differs only in terms of attribute levels and are asked to choose the option most preferred.

Within the choice set, the respondent is also presented with the option to do nothing or a baseline alternative referring to the status quo. This baseline is necessary to interpret the results in standard welfare economic terms (Hanley, Mourato, and Wright 2001). By including price or cost as one of the attributes of the good, willingness-to-pay can be indirectly estimated from the responses (Hanley, Mourato, and Wright 2001).

The respondents were given six choice scenarios; in each scenario they were asked to choose between two public transportation options that would be funded by this fee (Option A and Option B) or to choose neither of the two options (Neither). In each of the scenarios, different levels of each transportation attribute were presented to the respondent. The options in a scenario contained the same attributes but differed in the levels of the attributes. In the questionnaire, respondents were informed that to fund public transportation options which benefit rural elderly Texans, a fee will be added to the current costs of registering their vehicle. This fee amount constituted one attribute in each option. The attributes which characterize each transportation option in one choice scenario are: i) the addition to yearly registration fee; ii) days of operation; iii) hours of operation; iv) type of route; and v) fare discount given to senior citizens. An example of a scenario is in table 1.

The attributes and their levels are based upon previous surveys in the literature, although these surveys did not employ a choice survey format (Foster et al. 1996; Glasgow and Blakely 2000; Gombeski and Smolensky 1980; Grant and Rice 1983). The focus group discussions, as well as transportation experts were helpful in designing the level of transportation attributes. To assign levels to a particular choice set, each level of

Table 1. Example of a Transportation Option Choice Set

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | 22 | 3 | |
| Days of Operation | Monday through Friday | Seven Days a Week | |
| Hours of Operation | 8AM – 12 Midnight | 7AM – 5PM | |
| Type of Route | Fixed Route Service | Flexible Route Service | |
| Senior Citizen Transportation Fare per Ride | 50% discount off of full fare | 50% discount off of full fare | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

an attribute was assigned a distinct number, except the fee attribute which was continuous. Then random scenarios were generated based on these assignments. The levels of transportation attributes were independently and randomly chosen for a choice set, which were also independent across alternatives. The values used to generate the random scenarios are in Table 2.

Data Collection

The student survey was distributed to 507 students attending Texas A&M University. This sample of students was taken from selected classes taught at Texas A&M University-College Station within the College of Agriculture and Life Sciences and Mays Business School. The surveys were distributed on April 25, 26, and May 3, 2011.

Table 2. Random Scenario Draw Information

| Attribute | Attribute Levels | | |
|---|--|----------------------------------|-----------------------|
| Addition to Annual Registration Fee (dollars) | Uniformly distributed value between \$1.00 and \$30.00 | | |
| Days of Operation | Monday Wednesday Friday | Monday through Friday | Seven Days a Week |
| Hours of Operation | 7AM-12 Noon | 7AM-5PM | 8AM-12AM |
| Type of Route | Fixed Route | Flexible Route | Door-to-Door Route |
| Senior Citizen Transportation Fare per Ride | Full Fare | 50% Discount off of full fare | Free |

A second questionnaire was distributed by U.S. mail with a (postage paid) return envelope to 3,200 residents equally divided between Atascosa and Polk counties between the dates of September 15 and November 1, 2011. Atascosa County is located in South Texas near San Antonio, whereas, Polk County is located in the Piney Woods region of east Texas. The 2010 population of Atascosa County was 44,911 with the elderly population making up 11% of the total population (U.S. Census Bureau 2010b). Polk County's population of 45,413 has a higher percentage of elderly at 20% (U.S. Census Bureau 2010c). Both counties are among the Texas rural counties with the fastest growing elderly populations. From 2000-2009, the elderly population grew by 25% and 20% in Polk and Atascosa counties, respectively (U.S. Census Bureau 2000b, 2000c, 2010b, 2010c, 2010d, 2010e). Atascosa and Polk County are served by a rural public transportation systems, Alamo Regional Transit and The Brazos Transit District.

Names and addresses of residents were obtained through an open records request of the Polk and Atascosa County Appraisal District offices. The county questionnaire was distributed by mail based on Dillman's (1991) total design survey method. This approach involves three mailings. The first mailing made on September 15, included the questionnaire and a letter informing the recipient of the issue and inviting them to participate. On September 25, a reminder postcard was sent to those who had not responded to the first mailing. Finally, on October 5, the survey instrument was mailed to those people who had not responded. In addition, the local newspapers in Atascosa (*The Pleasanton Express*) and Polk (*The Polk County Enterprise*) counties each printed a news story, around the 15th of October, describing the survey and reminding people to participate in the survey.

The Random Utility Model and Model Specification

The random utility model (RUM) provides the theoretical basis for this study. McFadden (1974, 1978, and 1981) is often noted as a pioneer of discrete choice models in economics; his papers expand on the properties which link discrete choice to utility maximization. The RUM has been extensively used by previous studies in a variety of situations including: non-market valuations, health valuations, and situations involving choice models (Bockstael, Hanemann, and Strand 1984; Craig and Busschbach 2009; Horowitz 1991; Kataria et al. 2012; Lee and Mjelde 2007; Middleton 1991; Parsons and Kealy 1992; Rubey and Lupi 1997; Scarpa et al. 2009). The strength of this model is its ability to describe a decision maker's choice among a set of mutually exclusive alternatives in a statistically estimated form. The RUM is based on the notion that an

individual derives more utility from the chosen alternative than from those alternatives not chosen.

The indirect utility function, U_{in} , forms the basis for the RUM framework. In this framework, the utility that individual i receives from choosing alternative n can be obtained from a set of explanatory variables z_{in} and an unknown random component ε_{in} . We denote $z_{in} = [x_{in}, w_i]$ where w_i represents individual characteristics that vary across individuals but are the same for all alternatives presented to the same individual; and x_{in} includes attributes of alternatives that vary across alternatives and individuals. Given this information, the linear RUM for individual i choosing alternative n in a choice scenario t is (Greene 2003):

$$(1) \quad U_{int}(x_{int}, w_i) = z'_{int}\beta + \varepsilon_{int}$$

where U_{int} is the indirect utility function, β is a vector of parameters to be estimated, and the error term is denoted as ε_{int} .

The RUM assumes utility maximization such that decision maker i will choose alternative n over m in the choice scenario t , if and only if:

$$(2) \quad U_{int}(x_{int}, w_i) > U_{imt}(x_{imt}, w_i) \forall n \neq m.$$

Assumptions made about the distribution of the disturbance term and whether the coefficients are fixed or varying across individuals in the RUM model lead to the use of various qualitative models to estimate the RUM. Two variants of the logit model, conditional and mixed, are used in this study. The logit family of models is recognized as the essential toolkit for analyzing discrete choices because of their consistency with random utility theory (Hensher and Greene 2003).

Conditional Logit Model

For a given choice set, t , the probability that respondent i prefers alternative n over m is stated as the probability the utility associated with alternative n exceeds the utility associated with all the other alternatives indexed by m :

$$(3) \quad P(U_{int} > U_{imt} \forall n \neq m) = P\{(z'_{int}\beta - z'_{imt}\beta) > (\varepsilon_{imt} - \varepsilon_{int})\}.$$

To derive the probability in equation (3), the random errors $(\varepsilon_{int}, \varepsilon_{imt})$ are assumed to be identically and independently distributed with an extreme-value (Greene 2003):

$$(4) \quad F(\varepsilon_{int}) = \exp(-\varepsilon_{int}^{-\varepsilon_{int}})$$

where F is the distribution function of ε_{int} and \exp denotes the exponential function.

Using this assumption, McFadden (1974) specifies the conditional logit model. The probability of any specific alternative n being chosen as the most preferred among N total alternatives by individual i can be expressed as:

$$(5) \quad P_{int} = \frac{\exp(z'_{int}\beta)}{\sum_N \exp(z'_{int}\beta)}.$$

Each respondent chooses his / her preferred transportation option out of a total of N alternatives (Options A, B, or Neither). Let the variable y_{int} take a value of one if respondent i selects alternative n in choice scenario t , and zero otherwise. Because the error term is assumed to be independent over choice sets, the likelihood of individual i (L_i) to make the sequence of choices y_{int} , where $n=1, \dots, N$ and $t = 1, \dots, T$, is the product:

$$(6) \quad L_i = \prod_{t=1}^T \prod_{n=1}^N P_{int}^{y_{int}}.$$

The maximum likelihood approach, therefore, is used to estimate the parameters by maximizing the following log likelihood function

$$(7) \quad \log(L) = \sum_{i=1}^I \log(L_i) = \sum_{i=1}^I \sum_{t=1}^T \sum_{n=1}^N y_{int} \cdot \log(P_{int}) .$$

Mixed Logit Model

A conditional logit model assumes that the coefficients of covariates are constant among individuals, therefore, ignores heterogeneity. In the mixed logit model, the coefficients of independent variables can be either fixed or random. Assuming that the parameters β are random, the mixed logit probabilities are the integrals of standard logit probability over a density of parameters. The population distribution of β_i may be observed up to population parameters, θ , denoted by $f(\beta|\theta)$. The mixed logit probability that individual i chooses alternative n in choice set t is the integral of $P_i(y_i|z_{int}, \beta_i)$ over all potential values of β_i . Thus, equation (5) becomes:

$$(8) \quad P_{int} = \int \frac{\exp(z'_{int}\beta_i)}{\sum_N \exp(z'_{int}\beta_i)} \cdot f(\beta) .$$

Consequently, equations (6) and (7) are integrated over the density of the parameters β :

$$(9) \quad L_i = \prod_{t=1}^T \prod_{n=1}^N P_{int}^{y_{int}} = \prod_{t=1}^T \prod_{n=1}^N \left(\int \frac{\exp(z'_{int}\beta_i)}{\sum_N \exp(z'_{int}\beta_i)} f(\beta) \right)^{y_{int}}$$

$$(10) \quad \begin{aligned} \log(L) &= \sum_{i=1}^I \log(L_i) \\ &= \sum_{i=1}^I \sum_{t=1}^T \sum_{n=1}^N y_{int} \cdot \log \left(\int \frac{\exp(z'_{int}\beta_i)}{\sum_N \exp(z'_{int}\beta_i)} f(\beta) \right) . \end{aligned}$$

Because this integral does not have a closed form, a simulated maximum likelihood method is used to estimate the parameters of the population distribution of β . To achieve this, it is necessary to specify: 1) which independent variables have random and fixed coefficients (these variables are outlined in *Model Specification* section); 2) the distribution of each random coefficient; and 3) maximum likelihood simulation

techniques to be used for estimation. Interpretation of the mixed logit model is similar to the conditional logit model because they are analogous in origin and employ the same underlying theoretical basis, but the mixed logit model is able to address heterogeneity among individuals.

One advantage to the mixed logit model is that sample or individual-level parameters can be obtained. For further discussion on sample versus population coefficients see section *Mixed Logit-Variables with Random Coefficients*. Train (2003) provides information on estimating individual-level parameters, where an individual resides in the population distribution given his / her choices. Let $h(\beta|y_i, z_{int}, \theta)$ represent the distribution of β for the sample of people who would choose the sequences of choices y when facing a series of choice situation described by z_{ijt} . By Bay's rule:

$$(11) \quad h(\beta|y_i, z_{int}, \theta) \cdot P(y_i|z_{int}, \theta) = P(y_i|z_{int}, \beta) \cdot f(\beta|\theta).$$

which states the joint density of β and y_i can be defined as the probability of y_i times the probability of β conditional on y_i . Rearranging equation (11) returns

$$(12) \quad h(\beta|y_i, z_{int}, \theta) = \frac{P(y_i|z_{int}, \beta) \cdot f(\beta|\theta)}{P(y_i|z_{int}, \theta)}$$

where $P(y_i|z_{int}, \beta) \cdot f(\beta|\theta)$ is the product of the probability of y_i conditional on β and the probability of β , and $P(y_i|z_{int}, \theta)$ is the probability of y_i . Both the denominator and numerator of equation (12) are known based on the choice data and the population distribution's estimated parameters. Using equation (12), the mean β of each individual who would choose y_i , denoted by $\bar{\beta}(y_i)$, when facing z_{int} can be derived using:

$$(13) \quad \bar{\beta}(y_i) = \int h(\beta|y_i, z_{int}, \theta) \cdot \beta \cdot d\beta.$$

Again, this integral does not have a closed form, but can be simulated using details outlined by Train (2003, p. 263-267).

Model Specification

The dependent variable of both the conditional and mixed logit models is an index variable indicating whether a specific transportation option is chosen. Independent variables included are the transportation option attributes levels varied in the choice alternatives and socio-economic characteristics of the respondents (individual characteristics). To identify the impact of individual characteristics, a dummy choice outcome representing whether a transportation option (Option A or Option B) is chosen over Neither, is interacted with qualitative and continuous variables. These variables are used to examine whether certain groups of respondents, who have the above stated characteristics, are more or less likely to choose a transportation option over neither.

Variables with Fixed Coefficients. All independent variables have fixed coefficients in the conditional logit model. This, however, is not the case in the mixed logit model. As indicated previously the mixed logit model can include variables with both fixed and random coefficients. All individual specific characteristics are assumed to have fixed coefficients in the mixed logit model.

Although the coefficient for the additional annual registration fee of a transportation option is likely to be negative but differ in magnitude in the population, the coefficient of the registration fee is assumed to be fixed to simplify the willingness-to-pay calculations (outlined in the section *Estimating Preferences and Transportation Option Willingness-to-Pay*). Under this assumption the distribution of the willingness-

to-pay for each non-fee attribute has the same distribution type as the transportation attribute level's coefficient.

Mixed Logit-Variables with Random Coefficients. The coefficients for all transportation option attribute levels, except vehicle registration fee, are assumed to have random coefficients. As in previous random coefficient model literature, it is necessary to make a distinction between the population and the sample. In this study, three populations are considered: 1) the residents of Atascosa County; 2) the residents of Polk County; and 3) in-state students enrolled at Texas A&M University in the spring of 2011. Sample refers to the group of Atascosa County residents, Polk County residents, and Texas A&M University students who participated (responded to) in the choice survey.

To characterize heterogeneous preferences, distributions must be specified for the random coefficients associated with the various transportation option attributes. Respondents may have different preferences as to which transportation option attributes will best serve their elderly community members. People may prefer fewer days and hours of operation if they believe personal schedules can be altered to match the transportation schedule. Some people may believe a fare discount for senior citizens is necessary, whereas, others may think there should not be price discrimination based on age. It is assumed, therefore, the coefficients of transportation option attribute levels can be either positive or negative. Under this supposition, each of these coefficients is assumed to follow an independent normal distribution with mean and standard deviation to be estimated.

Estimating Conditional Logit Transportation Option Willingness-to-Pay. Let the conditional logit estimated coefficients associated with the additional vehicle registration fee be $\hat{\beta}_s$ and the transportation attribute k be $\hat{\beta}_k$. The mean willingness-to-pay (WTP) for the various transportation option attributes are then derived using the following formula (Hanley, Mourato, and Wright 2001):

$$(14) \quad WTP = -\frac{\hat{\beta}_k}{\hat{\beta}_s}.$$

In the conditional logit model, both $\hat{\beta}_k$ and $\hat{\beta}_s$ are fixed, therefore, WTP is also a fixed value. The mean WTP represents the amount the population is willing to pay to receive a transportation attribute level over the base level.

The standard deviation of the mean WTP derived from the conditional logit model is calculated using a Taylor Series Expansion (Wolter 2007). Let the estimated coefficients $\hat{\beta}_k = a$ and $\hat{\beta}_s = b$. The first-order Taylor series expansion at the point (a, b) is:

$$(15) \quad WTP(x, y) \approx WTP(a, b) + (x - a) \cdot WTP_x(a, b) + (y - b) \cdot WTP_y(a, b)$$

where $WTP(a, b)$ is $WTP(x, y)$ evaluated at the point (a, b) ; $WTP_x(a, b)$ is the partial derivative of $WTP(x, y)$ with respect to x evaluated at point (a, b) ; and $WTP_y(a, b)$ is the partial derivative of $WTP(x, y)$ with respect to y evaluated at point (a, b) . The variance of $WTP(a, b)$ is:

$$(16) \quad \sigma_{WTP}^2 = \sigma_{x-a}^2 \cdot (WTP_x(a, b))^2 + \sigma_{y-b}^2 \cdot (WTP_y(a, b))^2 + 2 \cdot WTP_x(a, b) \cdot WTP_y(a, b) \cdot Cov(x - a, y - b)$$

$$\begin{aligned}
&= \left(-\frac{1}{b}\right)^2 \cdot \sigma_{x-a}^2 + \left(\frac{a}{b^2}\right)^2 \cdot \sigma_{y-b}^2 + \\
&\quad 2 \cdot \left(-\frac{1}{b}\right) \cdot \left(\frac{a}{b^2}\right) \cdot \text{Cov}(x-a, y-b)
\end{aligned}$$

where $\sigma_{x-a}^2 = \text{var}(WTP_x(a, b))$, $\sigma_{y-b}^2 = \text{var}(WTP_y(a, b))$, and $\text{Cov}(x-a, y-b)$ is the covariance between $x-a$ and $y-b$. Because $\sigma_{x-a}^2 = \sigma_x^2$, $\sigma_{y-b}^2 = \sigma_y^2$, and $\text{Cov}(x-a, y-b) = \text{Cov}(x, y)$, the variance of the WTP can be re-written as:

$$(17) \quad \sigma_{WTP}^2 = \frac{1^2}{b} \cdot \sigma_x^2 + \frac{a^2}{b^4} \cdot \sigma_y^2 - 2 \cdot \left(\frac{a}{b^3}\right) \cdot \text{Cov}(x, y)$$

Therefore, the standard deviation of the WTP is:

$$(18) \quad \sigma_{WTP} = \sqrt{\frac{1^2}{b} \cdot \sigma_x^2 + \frac{a^2}{b^4} \cdot \sigma_y^2 - 2 \cdot \left(\frac{a}{b^3}\right) \cdot \text{Cov}(x, y)}.$$

Estimating Mixed Logit Preferences and Transportation Option Willingness-to-Pay. As previously stated, in the mixed logit model $\hat{\beta}_s$ is assumed to be constant and $\hat{\beta}_k$ is assumed to vary among individuals. These assumptions allow WTP to take on the same distribution as $\hat{\beta}_k$ (the normal distribution). Following the same notation, let the mixed logit estimated coefficient associated with the additional vehicle registration fee be $\hat{\beta}_s$, and the estimated mean parameter of the coefficient associated with transportation attribute k be $\hat{\beta}_k$. The mean WTP for transportation attribute k is then derived using the same formula as that specified in equation (14) for the conditional logit model:

$$(19) \quad \text{WTP} = -\frac{\hat{\beta}_k}{\hat{\beta}_s}.$$

Let the estimated standard deviation parameter of $\hat{\beta}_k$ be represented by $\hat{\sigma}_k$. Now, the standard deviation of the mean WTP can be calculated by:

$$(20) \quad \sigma_{\text{WTP}} = -\frac{\hat{\sigma}_k}{\hat{\beta}_s}.$$

Preference for transportation attribute k is defined as an individual having a positive WTP for transportation attribute k . The percentage of the population who prefer transportation attribute k is calculated using:

$$(21) \quad \text{Percent} = \left(1 - \varphi\left(-\frac{\text{WTP}}{\sigma_{\text{WTP}}}\right)\right) \cdot 100 = \left(1 - \varphi\left(-\frac{\hat{\beta}_k}{\hat{\sigma}_k}\right)\right) \cdot 100$$

where $\varphi\left(-\frac{\hat{\beta}_k}{\hat{\sigma}_k}\right)$ represents the normal cumulative distribution function evaluated at $-\frac{\hat{\beta}_k}{\hat{\sigma}_k}$, and WTP and σ_{WTP} are as previously defined.

Equations (19), (20) and (21) are altered slightly to be applied to the sample level coefficients derived from the mixed logit estimation. Let the coefficient associated with transportation attribute k for individual i be represented as $\hat{\beta}_{ki}$ for $i = 1 \dots I$, and the coefficient associated with the additional registration fee be defined as before. Now, the mean WTP for transportation attribute k is identified as:

$$(22) \quad \text{WTP} = \frac{-\sum_I \frac{\hat{\beta}_{ki}}{\hat{\beta}_s}}{I}.$$

The standard deviation of the mean WTP for transportation attribute k is calculated using the formula:

$$(23) \quad \hat{\sigma}_k = \sqrt{\frac{\sum_I \left(\frac{\hat{\beta}_{ki}}{\hat{\beta}_s} - \text{WTP}\right)^2}{I-1}}.$$

Now, the standard deviation of the mean WTP can be calculated using equation (20), and the percentage of the sample WTP distribution which prefers transportation attribute k is calculated using equation (21).

CHAPTER IV

EMPIRICAL RESULTS – STUDENT SURVEY

Students' Demographic Characteristics

Five hundred and seven questionnaires were issued to students, 493 were returned with 434 respondents providing enough information to be included in the analysis.

Respondents' qualitative and quantitative characteristics, as well as responses to Likert scale questions are summarized in Tables 3 and 4. Because two of the three surveyed classes were in the Department of Agricultural Economics, the majority of the students were from the College of Agriculture (65%). The students consisted of primarily juniors and seniors (41% and 35%). Almost all of the respondents were single (94%) with the majority of the respondents being white (81%). The gender of the respondents' was fairly even, with 52% being male and 48% being female. Half of the respondents (50%) reported their primary source of funding for school came from their parents; the other half were primarily self-funded. Most students (56%) described their dwelling in their home town as being located inside the city limits. The purpose of the questions pertaining to the respondents' subjective probabilities was to determine if the respondent believed that in the future he/she would be an elderly rural county resident who needed assistance with transportation; 18% of students believed they would be over the age of 75, living in a rural community, and needing assistance with transportation (answered with a subjective probability greater than 50% in all three categories).

The Likert⁴ scale questions (Table 4) were utilized to judge the respondents' knowledge and familiarity with transportation issues. The first set of questions were only to be completed by students who answered "yes" to the question, "Are there options to use public transportation in your hometown?" Of the students who knew there were public transportation options in their hometown, the majority were not familiar with the various aspects of their hometown public transportation (answered either 1 or 2 on the Likert scale). One hundred thirty two students were not familiar with the service area of the public transportation option, 168 were not familiar with how to schedule a trip, 188 were not familiar with the fare for a one-way trip, and 184 were not familiar with the availability of options for senior citizens.

The second set of questions, to be answered by all respondents, were intended to determine what training / characteristics students valued in operators of public transportation vehicles. The majority of students felt passing a background check (381), advanced first aid training (350), and CPR training (361) were important for drivers of public transportation to have (answered either 4 or 5 on the Likert scale). Finally, the third set of questions was used to determine what level of experience the students had with elderly transportation issues; 77% and 79% of students knew elderly family members and elderly friends who had at least some difficulty driving (answered either 3, 4 or 5 on the Likert scale).

⁴ In a Likert questionnaire item, respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements. The scale is named after its inventor, Rensis Likert (Likert 1932).

Model Estimation

Each respondent was provided six choices for six different choice sets giving 2,604 potential observations (6 x 434). The six choice observations are grouped by three categories (Option A, Option B, or Neither) for estimation, creating a total of 7,812 observations. However, 30 observations are dropped because of incomplete data. Therefore, 7,782 useable observations are obtained from the student sample.

The variables used in both the conditional and mixed logit models are provided in Table 5. The model includes variables which indicate the transportation attribute levels which were presented to each respondent. Fee enters the models as a positive, continuous variable. The transportation attribute levels enter the models as qualitative, 0-1, variables. To avoid perfect multi-collinearity, the least accommodating level of each transportation attribute is dropped from the model. The variable Choose takes on a value of 1 if the respondent chose one of the presented transportation options (did not choose Neither), otherwise the value is zero.

Along with the choice variables, continuous and discrete socio-demographic variables are included in each model. Examples of the continuous variables are the respondent's age (Age), experience with elderly transportation issues (Experience), and subjective probabilities (Old, Country, and Transport). Examples of the discrete socio-demographic variables include the respondent's gender (Male), ethnicity (White), and voting history (Voted). An interaction variable between Choose and each socio-demographic variable is used to determine which socio-demographic variables affect the respondents' decision to choose a transportation option.

Results from the conditional and mixed logit model estimations are in Tables 6 and 7. Summary statistics for both models are in Table 8 and chi-squared hypothesis tests of the equality of choice variable coefficients are in Table 9. Most coefficients associated with the variables in both models are significant at the 5% level or less ($\alpha \leq 0.05$), implying the factors included in the model play a statistically important role in the respondents' decision to choose a transportation option.

Conditional Logit Model

As expected, the additional fee's coefficient is negative; indicating as the fee increases then the respondent is less likely to choose a transportation option. All transportation option attribute level coefficients (M-F, Seven, 7AM to 5PM, 8AM to 12AM, Flexible, Door-to-door, Fifty, and Free) are interpreted relative to their respective base level. In this model, all transportation option attribute level coefficients are positive and statistically significant. Positive coefficients indicate an increase in the likelihood of choosing a transportation option with a specific attribute level relative to the base level (negative coefficients specify a reduction in the likelihood). The coefficients, for example, associated with Monday through Friday (M-F) and seven days a week (Seven) of operation indicate an increase in the likelihood of choosing a transportation option with these levels relative to an option which operates only on Monday, Wednesday, and Friday (MWF). As indicated by the coefficients' magnitudes, respondents are generally less likely to choose a transportation option with a less accommodating attribute level compared to one with a more accommodating option. The one exception being that the respondents slightly preferred a 7AM to 5PM service over an 8AM to 12AM service.

Within a transportation attribute category, the null hypothesis that the coefficients of the attribute levels are the same is tested using chi-squared tests (Table 9). Although the magnitudes of the coefficients associated with 7AM to 5PM and 8AM to 12AM services differed, the coefficients are not significantly different from each other. Coefficients associated with the days of operation (Monday through Friday versus seven days a week), type of route (flexible versus door-to-door), and fare (fifty percent discount versus free) are significantly different from each other.

Besides the transportation attributes, other variables which are significant are the interaction variables between Choose and the following: White, Dfund, Rural, City, Age, Country, Transport, and Experience. Interaction variables' coefficients between Choose and White, Transport, and Experience are positive. Compared to other ethnicities, a white respondent is more likely to choose a transportation option over neither. The more a respondent believes he/she will use transportation when over the age of 75 and the more experience a respondent has with elderly transportation issues, the higher the probability that the respondent will choose a transportation option over neither.

Interaction variables between Choose and Dfund, Rural, City, Age, and Country are negative. A respondent whose majority of funding for college came from their parents are less likely to choose a transportation option than a respondent who is primarily self-funded. Those respondents whose home county is located within a rural transit district are less likely to choose a transportation option than their metropolitan counterparts. Compared to those respondents who live outside the city limits, those who lived inside the city limits are less likely to choose a transportation option. As

respondents' age increases then he/she is less likely to choose a transportation option. Finally, the more the respondent believes he/she will live in the country when over the age of 75, the less likely it is the respondent will choose a transportation option.

Variables which were not significant in the conditional model are interaction variables between Choose and Male, Voted, Aware Public Transit, and Old. These traits (the respondent's gender, voting history, knowledge of public transportation in his/her home town, and subjective probability that he/she will live to be over the age of 75) are not statistically significant in impacting a respondent's decision to choose a transportation option.

Willingness-to-Pay. The coefficients for transportation option attributes are translated into WTP through additional fees on licensing a vehicle. These WTP's, in dollars per year, are given in Table 6. Positive WTP's specify the amount that respondents' are willing to pay for a specific attribute level compared to its base level. In this model, all WTP's are positive meaning respondents are willing to pay more for the attributes in the model than their base level. For all attributes, except hours of operation, respondents are willing to pay the least for the less accommodating level of an attribute, and more for the most accommodating levels. The conditional logit model shows the students' mean annual willingness-to-pay is (relative to the base level):

- 1) \$25 more for a seven day a week service and \$13 more for a Monday through Friday service than a Monday, Wednesday, Friday service;
- 2) \$23 more for an 8AM to 12 midnight service or a 8AM to 5PM service than a 7AM to 12AM service;
- 3) \$13 more for a door-to-door route and \$9 more for a flexible route than a fixed route; and

- 4) \$23 more for an option with free fare for senior citizens and \$18 more for an option which gives a 50% discount for senior citizens than an option which gives no discount.

Mixed Logit Model

Results from the mixed logit model are similar to the conditional logit model in terms of the transportation attributes. The additional fee's coefficient is statistically significant and negative; whereas, all transportation option attribute level are statistically significant and positive. The coefficient inferences, therefore, remain the same. Including these attributes increases the probability that a respondent will choose a transportation option over another. Similar to the conditional model, coefficients for transportation attributes, except for hours, are statistically different from each other (Table 9).

Interactions between Choose and White, Rural, Country, and Transport are significant at the 5% level. Two differences between the conditional logit and mixed logit in terms of significance are noted. The interaction variable between Choose and City, which was significant at the 5% level in the conditional logit is significant at the 8% level in the mixed logit model. Further, the interaction between Choose and Dfund and Choose and Age are not significant in the mixed logit model. Other variables which are not significant in the conditional logit model are also not significant in the mixed model. All coefficients for the variables in the mixed logit model have the same sign as in the conditional model, resulting in the same inference.

Willingness-to-Pay. As in the conditional model, the coefficients for transportation option attributes in the mixed model are translated into yearly WTP

(Table 7). The resulting WTP's are similar to those calculated in the conditional logit model. The student population is willing to annually pay:

- 1) \$24 more for a seven day a week service and \$13 more for a Monday through Friday service than a Monday, Wednesday, Friday service;
- 2) \$23 more for an 8AM to 12 midnight service and \$24 more for a 8AM to 5PM service than a 7AM to 12AM service;
- 3) \$12 more for a door-to-door route and \$7 more for a flexible route than a fixed route; and
- 4) \$22 more for an option with free fare for senior citizens and \$18 more for an option which gives a 50% discount for senior citizens than an option which gives no discount.

One advantage of the mixed logit model is the percentages of the student population and sample (see *Methodology* for explanation of population versus sample) that prefer the attribute over the base attribute (indicated by a positive WTP) can be calculated:

- 1) 78% of the student population and 94% of the student sample prefer Monday through Friday service over Monday, Wednesday, Friday service;
- 2) 87% of the student population and 98% of the student sample prefer seven day a week service over Monday, Wednesday, Friday service;
- 3) 89% of the student population and 99% of the student sample prefer 7AM to 5PM service over 7AM to 12PM service;
- 4) 81% of the student population and 93% of the student sample prefer 8AM to 12AM service over 7AM to 12PM service;
- 5) 77% of the student population and 98% of the student sample prefer a flexible route over a fixed route;
- 6) 66% of the student population and 76% of the student sample prefer a door-to-door route over a fixed route;

7) 87% of the student population and 99% of the student sample prefer a 50% discount over no discount for senior citizens; and

8) 92% of the student population and 100% of the student sample prefer free fare over no discount for senior citizens.

Differences between the Conditional Logit and Mixed Logit Models

The estimated variable coefficients are similar between both models. In terms of significance, the largest difference between the conditional and mixed logit models is the coefficient for the interaction variable between Choose and Age. In the conditional model, this coefficient is significant at the 5% level, but in the mixed logit model its significance is at the 46% level. There are two notable differences between the two models for the WTP of route attribute levels. In the mixed logit model, students are willing to pay almost 27% less for a flexible route service and 8% less for a door-to-door service than in the conditional model.

Both models have approximately the same correct predictions (62%). The conditional logit model, however, slightly outperforms the mixed logit model with 1,619 correct predictions (compared to 1,600). The standard deviations of the variables with random coefficients in the mixed logit model, however, are highly significant (except the coefficient for a flexible route which is significant at the 15% level). Significance of the standard errors indicates these coefficients vary within the population (Table 7). Based on these tests, it is concluded that the mixed logit model is statistically preferred to the conditional logit model.

CHAPTER V

EMPIRICAL RESULTS – COUNTY SURVEY

Respondents' Demographic Characteristics - Atascosa County

One thousand six hundred questionnaires were sent to Atascosa County residents, 389 were returned, with 235 respondents providing enough information to be included in the analysis. The 235 respondents' qualitative and quantitative characteristics and their responses to Likert scale questions are summarized in Tables 10 and 11. Average age of the respondents in Atascosa County was 57 years old which is older than the median age, 36 years, reported by the U.S. Census Bureau (2011). This age difference is most likely attributed to the fact that the survey sample only contained property owners which is generally an older age group. The majority of respondents were white (58%), followed by Hispanic (39%), and multiracial plus other (3%). Census data indicates 62% of Atascosa residents are Hispanic, 36% are white, and less than 1% are multiracial (U.S. Census Bureau 2011). Most respondents were married (74%), which is higher than the reported husband-wife family households (42%) reported by the U.S. Census Bureau (2011). Atascosa County's population is approximately 49% male and 51% female (U.S. Census Bureau 2011); however, more males (57%) were represented in the sample than females (43%).

The majority of respondents had at least some college education (65%). Most respondents described their dwelling in their home town as being located outside the city limits (55%), voted in their last national, state, or local election (83%), and did not know

about the public transportation options available in Atascosa County (67%). Twenty-six percent of Atascosa County respondents believed they will live to be over the age of 75, live in a rural community, and need assistance with transportation (answered with a subjective probability greater than 50% in all three categories).

Similarly to the student survey, the purpose of the Likert scale questions were utilized to judge the respondents' knowledge and familiarity with transportation issues. Only respondents who responded 'yes' to the question, "Are there options to use public transportation in your hometown," completed the first set of Likert scale questions. Of the respondents who knew there were public transportation options in their hometown, the majority were not familiar with the various aspects of their hometown public transportation (answered either 1 or 2 on the Likert scale). Fifty-nine were not familiar with the service area of the public transportation option, 65 were not familiar with how to schedule a trip, 65 were not familiar with the fare for a one-way trip, and 59 were not familiar with the availability of options for senior citizens.

The second set of questions, to be answered by all respondents, were intended to determine which training characteristics residents valued in operators of public transportation vehicles. The majority felt passing a background check (224), advanced first aid training (211), CPR training (215), and equipment training (211), and multilingual abilities (138) were important for drivers of public transportation to have (answered either 4 or 5 on the Likert scale). Finally, the third set of questions was used to determine what level of experience the residents had with elderly transportation

issues. Sixty-seven percent of respondents knew elderly family members and elderly friends who had at least some difficulty driving (answered 3, 4 or 5 on the Likert scale).

Respondents' Demographic Characteristics - Polk County

As with the survey of Atascosa County, 1,600 questionnaires were sent to residents of Polk County. Three hundred twenty four residents returned a questionnaire, with 163 respondents providing enough information to be included in the analysis. A summary of the 164 respondents' qualitative and quantitative characteristics, as well as, responses to Likert scale questions, are given in Tables 12 and 13. The average age of the respondents in Polk County was 60 years old which is older than the median age, 43 years, reported by the U.S. Census Bureau (2011). Again, this age difference is most likely attributed to the fact that the survey sample only contained property owners. The majority of respondents were white (91%), followed by African American (4%), Hispanic (2%), and other (2%). Most respondents were married (72%). The U.S. Census Bureau (2011) reports 72% of Polk County residents are white, followed by Hispanic (13%), African American (11%), and other (less than 1%). The gender of the respondents' was fairly even, with slightly more females (52%) than males (48%). The U.S. Census Bureau (2011), however reports that the Polk County population has a larger percentage of males (54%) than females (46%).

The majority of the respondents had at least some college education (76%). More respondents described their dwelling in their home town as being located outside the city limits (86%), voted in their last national, state, or local election (88%), and did not know about the public transportation options available in Polk County (62%).

Thirty-two percent of Polk County respondents believed they would be over the age of 75 living in a rural community and needing assistance with transportation (answered with a subjective probability greater than 50% in all three categories).

Of the respondents who knew there were public transportation options in their hometown, the majority were not familiar with the various aspects of their hometown public transportation (answered either 1 or 2 on the Likert scale). Forty-one were not familiar with the service area of the public transportation option, 45 were not familiar with how to schedule a trip, 49 were not familiar with the fare for a one-way trip, and 43 were not familiar with the availability of options for senior citizens. The majority felt passing a background check (153), advanced first aid training (128), CPR training (131), disability equipment training (133) were extremely important for drivers of public transportation to have (answered either 4 or 5 on the Likert scale). In contrast to Atascosa County, multilingual training was seen as less important to Polk County respondents. Sixty-one percent and 71% of respondents knew elderly family members and elderly friends who had at least some difficulty driving (answered 3, 4 or 5 on the Likert scale).

Model Estimation

As in the student survey, each respondent was presented with six different choice sets giving 1,410 (6 x 235) potential observations for Atascosa County and 978 (6 x 163) for Polk County. The six choice observations are grouped by three categories (Option A, Option B, or Neither) for estimation which creates a potential 4,230 and 2,934 observations in Atascosa and Polk counties. However, 165 observations are dropped

from the Atascosa sample and 182 observations are dropped from the Polk sample because of incomplete data. Therefore, 4,065 useable observations are obtained from Atascosa County and 2,752 from Polk County.

The variables used in both the conditional and mixed logit models for both counties are provided in Table 14. The model includes variables which indicate the transportation attribute levels which were presented to each respondent. These variables are the same as in the student models. Fee enters the models as a positive, continuous variable. The transportation attribute levels enter the models as qualitative, 0-1, variables. To avoid perfect multi-collinearity, the least accommodating level of each transportation attribute is dropped from the model. The variable Choose takes on a value of 1 if the respondent chose one of the presented transportation options (did not choose Neither), otherwise the value is zero.

Along with the choice variables, continuous and discrete socio-demographic variables are included in each model. Continuous variables are the respondent's age (Age), experience with elderly transportation issues (Experience), and subjective probabilities (Old, Country, and Transport). Examples of the discrete socio-demographic variables include the respondent's gender (Male), ethnicity (White), and education level (College). An interaction variable between Choose and each socio-demographic variable is used to determine which socio-demographic variables affect the respondents' decision to choose a transportation option.

To determine if it would be appropriate to estimate a separate model for each county, the data for both counties was arranged in a block format and both a conditional

and mixed logit models are estimated that include both Polk and Atascosa County coefficients. A joint chi-squared test is used to determine if the Polk County coefficients are statistically different from their Atascosa counterparts. Three tests are conducted, the choice variables (fees, hours, route, discount and days) only, socio-demographic variables only, and all variables. The choice variables' coefficients jointly do not differ at the 0.77 level in the conditional logit model and at the 0.95 level in the mixed logit model. The socio-demographic variables' coefficients differed at the 0.00 level in the conditional and mixed logit models. All variables' coefficients differed at the 0.00 level in the conditional and mixed logit models. These results suggest that Polk and Atascosa County variables' coefficients are statistically different; the models should be estimated separately.

Results from the conditional and mixed logit model estimations for Atascosa County are in Tables 15, and 16. Polk County estimation results are in Tables 17 and 18. Summary statistics for both models of each county are in Table 19. Chi-squared hypothesis tests of the equality of choice variable coefficients are in Table 20.

Conditional Logit Model - Atascosa County

Similar to the student model, the additional fee's coefficient is negative, indicating as the fee increases on a given transportation option the respondent is less likely to choose a transportation option. All transportation option attribute level coefficients are positive and statistically significant at the 5% level or less (except Flexible which is significant at the 13.5% level). As indicated by the coefficients' magnitudes, respondents are less likely to choose a transportation option with a less accommodating attribute level

compared to one with a more accommodating option. The null hypothesis that the coefficients of the attribute levels within a category are the same is tested using chi-squared tests (Table 20). Coefficients associated with Monday through Friday and seven day a week services are not significantly different from each other. Similarly the coefficients for 7AM to 5PM and 8AM to 12AM services do not differ. Coefficients associated with the type of route (flexible versus door-to-door) and fare (fifty percent discount versus free) are significantly different.

In addition to the transportation attributes, other variables which are significant are interaction variables between Choose and the following: Single, all income variables, College, City, Age, Country, Transport, and Experience. The interaction variables' coefficients between Choose and Single, all income variables, City, Transport, and Experience are positive. Compared to those who are married a single respondent is more likely to choose a transportation option over neither. Those who have a before-tax household income greater than \$24,999 are more likely to choose a transportation option. A respondent whose home is located within the city limits is more likely to choose a transportation option over neither. Also, the more a respondent believes he/she will use transportation when over the age of 75 and more experience a respondent has with elderly transportation issues the higher the probability that the respondent will choose a transportation option over neither.

The interaction variables between Choose and College, Age, and Country are negative. A respondent who attended college is less likely to choose a transportation option than a respondent who attended at most high school. As the respondent's age

increased then he/she was less likely to choose a transportation option. Finally, the more the respondent believes he/she will live in the country when over the age of 75, the less likely it is the respondent will choose a transportation option.

Variables which are not significant in the conditional model are the interaction variables between Choose and Male, White, Only Far Children, Only Far Children*Age, Voted, Aware Public Transit, and Old. These characteristics (the respondent's gender and ethnicity, where the respondent's children lived, whether or not he/she voted, knew about public transportation in their home town and whether the respondent believed he/she would live to be over the age of 75) are not statistically significant in impacting a respondent's decision to choose a transportation option.

Willingness-to-Pay. As in the student model, all mean WTP's are positive (Table 15), indicating respondents are willing to pay more for the attributes in the model than their base level. In general, respondents are willing to pay the least for the less accommodating level of an attribute, and more for the more accommodating levels. The conditional logit model shows Atascosa County residents are willing to annually pay:

- 1) \$8 more for a seven day a week service and \$6 more for a Monday through Friday service than a Monday, Wednesday, Friday service;
- 2) \$15 more for an 8AM to 12 midnight service and \$13 more for a 7AM to 5PM service than a 7AM to 12AM service;
- 3) \$14 more for a door-to-door route and \$3 more for a flexible route than a fixed route; and
- 4) \$19 more for an option with free fare for senior citizens and \$13 more for an option which gives a 50% discount for senior citizens than an option which gives no discount.

Conditional Logit Model - Polk County

Again, the additional fee's coefficient is negative; as the fee increases on the transportation option then the respondent is less likely to choose the option (Table 17). Similar to the Atascosa County model, all transportation option attribute level coefficients are positive and statistically significant. The one exception is the coefficient for a flexible route, which is not significant in the Atascosa model but is now significant at the 5% level. When considering only magnitudes of the coefficients, respondents are more likely to choose a transportation option with a more accommodating attribute level than a less accommodating one. The only exception is in the case of hours of operation. Only the route attribute levels' coefficients (Flexible versus Door-to-Door), however, are statistically different from one another (Table 20).

Interaction variables which are significant are interactions between Choose and the following: Male, White, Only Far Children, Only Far Children*Age, City, Aware Public Transit, Country, and Transport. Interaction variables' coefficients between Choose and City, and Aware Public Transit are positive. A respondent whose home is within the city limits is more likely to choose a transportation option over neither. A respondent who is aware of the transportation options in Polk County is more likely to choose a transportation option over neither.

Interaction variables between Choose and Male, White, Country, and Transport are negative. A male respondent is less likely to choose a transportation option than a female respondent. Compared to other ethnicities, a white respondent is less likely to choose a transportation option over neither. Finally, the more the respondent believes

he/she will live in the country or use alternative forms of transportation when over the age of 75, the less likely it is the respondent will choose a transportation option.

The interaction between Choose and Only Far Children is difficult to interpret. This is because the coefficient associated with the interaction between Choose and Only Far Children*Age is positive, but the coefficient associated with the interaction between Choose and Only Far Children is negative. The effect of these two coefficients along with age is necessary to determine the overall effect of Only Far Children on the probability of a respondent choosing a transportation option.

Variables which are not significant in the conditional model are the interaction variables between Choose and Single, all income variables, College, Voted, Age, Old, and Experience. These characteristics (the respondent's marital status, age and income, whether the respondent attended college, whether or not he/she voted, and whether the respondent believed he/she would live to be over the age of 75) are not statistically significant in impacting a respondent's decision to choose a transportation option.

Willingness-to-Pay. Respondents, generally, are willing to pay the least for the less accommodating and more for more accommodating levels (Table 17). The conditional logit model shows Polk County residents' annual mean WTP is:

- 1) \$10 more for a seven day a week service and \$10 for a Monday through Friday service than a Monday, Wednesday, Friday service;
- 2) \$13 more for an 8AM to 12 midnight service and \$14 more for a 7AM to 5PM service than a 7AM to 12AM service;
- 3) \$13 more for a door-to-door route and \$5 more for a flexible route than a fixed route; and

- 4) \$16 more for an option with free fare for senior citizens and \$14 more for an option which gives a fifty percent discount for senior citizens than an option which gives no discount.

Mixed Logit Model - Atascosa County

As in the student model, the results from the mixed logit model (Table 16) are similar to the conditional logit model, in terms of the transportation attributes. The additional fee's coefficient is statistically significant and negative. All transportation option attribute level coefficients are positive and are statistically significant, except for M-F and Flexible. The coefficient inferences, therefore, remain similar. These attributes increase the probability that a respondent will choose a transportation option over another. Also, similar to the conditional model, coefficients for the route and senior citizen discount attributes are statistically different from each other (Table 20).

Interactions between Choose and Single, Income_3, Income_4, City, Voted, Aware Public Transit, and Age are significant at the 5% level. Differences between the conditional logit and mixed logit in terms of significance are noted. The interaction variable between Choose and Experience, which was significant at the 5% level in the conditional logit is significant at the 6% level in the mixed logit model. Further, the interactions between Choose and Income_2, College, Country, and Transport, and are not significant in the mixed logit model, but are significant in the conditional logit model. Interactions between Choose and Aware Public Transit and Voted are not significant in the conditional model, but are significant in the mixed logit model. Interaction variables between Choose and Male, White, Only Far Children, Only Far Children*Age, and Old are not significant in the conditional logit model and are also not

significant in the mixed logit model. All coefficients for the variables in the mixed logit model have the same sign as in the conditional logit model, resulting in the same inference.

Willingness-to-Pay. As in the conditional model, the coefficients for transportation option attributes in the mixed model were translated into yearly WTP (Table 16). The resulting mean WTP's are generally lower than the WTP's calculated for the conditional logit model. The Atascosa County resident population is willing to annually pay:

- 1) \$7 more for a seven day a week service and \$4 more for a Monday through Friday service than a Monday, Wednesday, Friday service;
- 2) \$14 more for an 8AM to 12 midnight service and \$11 more for a 8AM to 5PM service than a 7AM to 12AM service;
- 3) \$11 more for a door-to-door route and \$3 more for a flexible route than a fixed route; and
- 4) \$18 more for an option with free fare for senior citizens and \$10 more for an option which gives a fifty percent discount for senior citizens than an option which gives no discount.

As mentioned in the student mixed logit model results, one advantage to the mixed logit model is the percentages of the population and sample (see *Methodology* for explanation of population versus sample) which prefers the attribute over the base attribute (indicated by a positive WTP) can be calculated:

- 1) 59% of the resident population and 67% of the resident sample prefer Monday through Friday service over Monday, Wednesday, Friday service;
- 2) 70% of resident population and 84% of the resident sample prefer seven day a week service over Monday, Wednesday, Friday service;

- 3) 76% resident population and 90% of the resident sample prefer 7AM to 5PM service over 7AM to 12PM service;
- 4) 72% resident population and 79% of the resident sample prefer 8AM to 12AM service over 7AM to 12PM service;
- 5) 59% of the resident population and 66% of the resident sample prefer a flexible route over a fixed route;
- 6) 69% of the resident population and 78% of the resident sample prefer a door-to-door route over a fixed route;
- 7) 82% of the resident population and 95% of the resident sample prefer a 50% discount over no fare discount for senior citizens; and
- 8) 91% of the resident population and 99% of the resident sample prefer free fare over no fare discount for senior citizens.

Mixed Logit Model - Polk County

Results from the Polk County mixed logit model (Table 18) are similar to the conditional logit model, for the transportation options. The additional fee's coefficient is statistically significant and negative. All transportation option attribute level coefficients are positive and statistically significant, except Flexible. Coefficient inferences, therefore, remain the same. These attributes increase the probability that a respondent will choose a transportation option over another. Also, only the coefficients of route attribute category are statistically different from each other (Table 20).

Only Interactions between Choose and Male, and Choose and White are significant at the 5% level. The main difference between the conditional logit and mixed logit model is that all coefficients (excluding the interaction variables between Choose and Male, and White) which are significant in the conditional model at the 5% level are not significant using mixed logit estimation. Most coefficients for the variables in the

mixed logit model have the same sign as in the conditional model, resulting in the same inference. The coefficients of the interaction variables between Choose and Voted, Age, Old, and Transport, however, are opposite in sign from the conditional model.

Willingness-to-Pay. The Polk County resident population's mean annual WTP are:

- 1) \$7 more for a seven day a week service and \$6 more for a Monday through Friday service than a Monday, Wednesday, Friday service;
- 2) \$9 more for an 8AM to 12 midnight service and \$8 more for a 8AM to 5PM service than a 7AM to 12AM service;
- 3) \$11 more for a door-to-door route and \$4 more for a flexible route than a fixed route; and
- 4) \$13 more for an option with free fare for senior citizens and \$10 more for an option which gives a 50% discount for senior citizens than an option which gives no discount.

The percentages of the population and sample (see *Methodology* for explanation of population versus sample) which prefers the attribute over the base attribute are:

- 1) 67% of the resident population and 79% of the resident sample prefer Monday through Friday service over Monday, Wednesday, Friday service;
- 2) 68% of the resident population and 77% of the resident sample prefer seven day a week service over Monday, Wednesday, Friday service;
- 3) 71% of the resident population and 84% of the resident sample prefer 7AM to 5PM service over 7AM to 12PM service;
- 4) 72% of the resident population and 79% of the resident sample prefer 8AM to 12AM service over 7AM to 12PM service;
- 5) 62% of the resident population and 69% of the resident sample prefer a flexible route over a fixed route;
- 6) 79% of the resident population and 88% of the resident sample prefer a door-to-door route over a fixed route;

7) 90% of the resident population and 99% of the resident sample prefer a 50% discount over no fare discount for senior citizens; and

8) 83% of the resident population and 91% of the resident sample prefer free fare over no fare discount for senior citizens.

Differences between the Conditional Logit and Mixed Logit Models

Contrary to the student models, there are significant differences between the Atascosa County and Polk County mixed and conditional logit models. Although the estimated variable coefficients maintain a similar magnitude and the same sign between both models, variables which are significant in the conditional model do not maintain their significance in the mixed logit model. Also, in Atascosa County the population's mean WTP is generally lower for the mixed logit model than for the conditional logit model. Specifically, the highest differences in WTP are seen for seven day a week service (40% less), flexible and door-to-door route (20% and 31% less), and fifty percent fare discount for senior citizens (26% less). Similar to Atascosa County, there are notable differences between the WTP's in Polk County's mixed and conditional logit models. On average, there is almost a 50% difference between the mixed and conditional logit mean WTP. The highest difference in WTP (82%) is found between the mean WTP for the 7AM to 5PM hours of operation level.

In the case of Atascosa County, both the conditional and mixed logit models have about the same correct predictions (55% and 54%). The conditional logit model, however, slightly outperforms the mixed logit model with 749 correct predictions compared to 738 for the mixed logit model. For Polk County again, the conditional logit model slightly outperforms the mixed logit model with 505 correct predictions

compared to 500. In both the Atascosa County and Polk County models, the standard deviations of the variables with random coefficients in the mixed logit model, however, are highly significant (see *Standard Deviations of Variables with Random Coefficients* section in Tables 16 and 18). This significance indicates these coefficients vary within both populations. Based on these analyses, it is concluded that the mixed logit model is preferred to the conditional logit model for both Atascosa and Polk County.

CHAPTER VI

POPULATION AND INDIVIDUAL WILLINGNESS-TO-PAY (WTP) COMPARISONS

Conditional Logit WTP Comparisons

Comparisons of each population's WTP and the standard deviation of its WTP calculated from the conditional logit estimation are found in Table 21 and Figure 4. Overall, the student population is willing to pay more for all transportation option attribute levels, except for door-to-door service, than the county residents. Polk County residents' mean WTP is larger than that of Atascosa county residents for five of the eight attribute levels. The standard deviations for the attributes range from \$2 to \$3.23. Polk County residents have the highest standard deviation in four WTP categories (Monday-Friday service, flexible route, door-to-door route, and fifty percent fare discount). Students have the highest standard deviation in three categories (seven day a week service, 7AM to 5PM service, and 8AM to 12AM service). Atascosa County residents have the highest standard deviation in one category, free senior citizen fare.

Mixed Logit WTP Comparisons

Population Comparisons

Similar to the conditional logit models, the student population is willing to pay more for each transportation attribute level than both county resident populations (Figure 5). The smallest differences are seen in the student's and county residents' WTP for a door-to-door route; students are willing to pay 11% more than the county residents. Between

most attributes, however, the difference is greater than 60%. For instance, students are willing to pay almost 270% more for seven day a week service than both the Atascosa and Polk County resident populations. The Atascosa and Polk Counties population WTP's are similar, several WTP's (Fifty, Door-to-Door, Seven) differ by less than 5%. The largest difference is seen in the hours of operation attribute. There is a 57% difference in the Atascosa and Polk populations' WTP for 8AM to 12AM hours of operation and a 44% difference in their WTP for 7AM to 5PM hours.

As mentioned in the previous two chapters, one benefit to using the mixed logit model is that a percentage of the population who prefer a specific attribute can be calculated. A higher percentage of the student population prefers most attribute levels over the base than the two county resident populations (Figure 6). More Polk County residents, however, prefer a fifty percent discount and door-to-door service than students or Atascosa County residents.

Sample Comparisons

Another advantage to employing the mixed logit model is that individual coefficients for the variables with random coefficients are calculated. These individual level coefficients are used to calculate individual WTP. Using the mean and standard deviation of the sample's individual WTP's, the normal distribution is used (each variable is assumed to be normally distributed) to create a probability density function to represent each sample's WTP (Figures 7 through 14). The WTP distribution of the students, Atascosa and Polk County residents are represented in each Figure, allowing the distributions to be easily compared.

Days of Operation. The Atascosa County sample has the highest variance in WTP for Monday through Friday service, followed by the student then the Polk County sample (Figure 7). More Atascosa residents prefer the base level (Monday, Wednesday, Friday service) over Monday through Friday service than either the students or Polk residents, as given by negative WTP's. Students, following the population results, had a higher mean WTP for this level, followed by Polk then Atascosa residents. Similar to the population results, the students have the highest mean WTP for seven days a week of operation (Figure 8). Atascosa and Polk County samples had approximately the same mean WTP (Atascosa County's is slightly higher). The students, however, have a notably larger variance than the county residents. Some students are willing to pay up to \$60 for seven day a week service.

Hours of Operation. Following the population results, students had the highest mean WTP for 7AM to 5PM service, followed by Atascosa then Polk County residents (Figure 9). The variances of each sample's WTP are similar. The means of the 8AM to 12AM service distributions follow the same pattern as the population WTP; students are willing to pay the most followed by Atascosa and Polk residents (Figure 10). The Atascosa County resident and student WTP distribution variances are similar; the student distribution looks like the Atascosa distribution shifted to the right. The Polk resident WTP distribution has a much smaller variance.

Type of Route. The variance of the students' WTP for a flexible route is notably smaller than either of the counties' variances (Figure 11). The county variances are larger with a large proportion of both WTP distributions falling into negative values;

more of the county residents prefer a fixed to a flexible route. Very few of the students' WTP's fall into the negative range; this shows an almost unanimous preference for the flexible over the fixed route. Following the population means, the students' sample distribution mean WTP is larger than the either of the counties' mean WTP's. The Polk and Atascosa County distributions are similar, they almost lay atop of each other. The distribution means of all three samples are very similar for the WTP for a door-to-door route (Figure 12). The student mean WTP, however, is slightly larger than the two counties. Atascosa County's mean WTP is slightly larger than the Polk County mean WTP. The variances of the student and Atascosa County WTP distributions are similar. The Polk County WTP distribution has a smaller variance than the other two samples.

Senior Citizen Transportation Fare Discount. Again, the sample distribution mean WTP for a fifty percent fare discount for senior citizens follow the population distribution means; students have a larger mean WTP than the counties (Figure 13). The two counties' mean WTP's are almost equal. The majority of all three distributions fall in a positive WTP range indicating the students and residents prefer a fifty percent discount over senior citizens not receiving a fare discount. As with the fifty percent discount distributions, the greater part of the full fare discount WTP distributions are positive (Figure 14). The variance of each sample's WTP is similar, but the mean WTP's differ among the samples.

Attribute Level WTP Distribution Comparisons. The null hypothesis that the WTP distributions of two population samples are equal is tested using a two-sample Wilcoxon-Mann-Whitney rank-sum test (Table 22). The student WTP distributions are

significantly different from the county samples' distributions, except for the WTP distributions for the door-to-door route for students and Atascosa County. In contrast, one-half of the Polk and Atascosa County samples' distributions are statistically similar. The WTP distributions for seven day a week service, flexible route, door-to-door route, and 50% fare discount for senior citizens are significantly the same between Polk and Atascosa County residents.

CHAPTER VII

CONCLUSIONS AND DISCUSSION

Mobility is an undeniable issue for current and future elderly populations. Concern for mobility is seen throughout community development and gerontology literature. The increasing popularity for retirees to live in rural communities and the outmigration of younger people make this a particularly important issue in rural towns. Respondents from the county survey shared these concerns:

“As I am getting older, I have a real fear of losing my driving ability (or eyesight) someday, and having to leave my home and move into town.”

“I believe there is a need for public transportation for the elderly. My mother (83 years) and aunt (84) do not drive and sometimes need a ride to the doctor or grocery store. And sometimes the relatives are unable to take them because they work. I am 59 years old. I drive but maybe later I might need a ride myself.”

Resultant issues that come with living in a rural area (limited access to health services, shopping, and social activities) may be exacerbated when one can no longer drive. Most existing rural public transportation options do not promote an independent lifestyle if used as the primary form of transportation for daily activities.

From previously published studies, it is clear that elderly rural community members feel their public transportation options are limited, decreasing their quality of life. Few if any, research has addressed this problem from the perspective of the general public's opinions of or willingness-to-pay for services that enhance the mobility of the elderly. The research in this thesis is a first step towards addressing this deficiency in the literature by estimating the willingness-to-pay for transportation options which

support the rural elderly. An updated rural transportation system would most likely need to be funded by taxpayers; an understanding of the public's preferences and willingness-to-pay for transportation options is essential. The objectives of this research are to: (1) estimate economic willingness-to-pay (WTP) for various public transportation options by using choice modeling techniques, namely, conditional and mixed logit estimation; and (2) better understand opinions related to public transportation for the elderly held by the general population as a whole and within different demographics. Three populations were sampled; residents of two Texas counties and students at Texas A&M University. These populations were selected because each will play a unique role in updating the transportation system. An updated rural transportation system would affect county residents sooner than students, but students will pay for an updated system longer than many current county residents. Atascosa and Polk Counties were selected to determine if WTP preferences differ by county. Both are rural counties located in two different regions of Texas. Atascosa County is located in south Texas near the city of San Antonio, whereas, Polk County is located in the Piney Woods region of east Texas.

Transportation Preferences and Willingness-to-Pay

Given the results of the WTP models, it is clear that both students and the general public value public transportation options and are willing to pay for specific transportation attributes. One interesting finding is that respondents prefer options which have more flexible attributes than the assumed base attribute, but they did not necessarily prefer the most flexible options. In all three samples, for example, respondents prefer either a 7AM to 5PM service or 8AM to midnight service over the base service of 7AM to noon.

There, however, is no statistical significant preference for a 7AM to 5PM over 8AM to midnight service. Put another way, Atascosa and Polk County residents, along with the students, prefer an option that included more than just a morning service, but are indifferent between services which end at 5 PM or last until midnight.

In contrast, to the hours of service, respondents in all three samples prefer the most flexible option, door-to-door service over fixed or flexible routes. Preferences for days of operation vary somewhat between the samples. Both counties residents prefer either a Monday through Friday service or a seven day a week service over the base of a Monday, Wednesday, and Friday service. There, however, is no statistical significance preference for a seven day a week service over a Monday through Friday service. Students, however, preferred a seven day a week service to either of the other service days. All respondents prefer some type of fare discount for senior citizens. In the student and Atascosa models, the coefficients associated with a fifty percent discount and free fare for senior citizens are significantly different; this is not the case in the Polk County model. The above results suggest the type of transportation attribute will have an effect on the preference for additional flexibility. Further, it appears there are sample differences between preferences for these attributes.

Comparison of Results between Polk and Atascosa Counties

Residents from two different counties were used in this survey because residents of these two counties might view transportation options differently. Overall, both Atascosa and Polk County residents had similar WTP's, indicating that both populations value rural public transportation similarly. Using a block diagonal set-up of the data (see Chapter

V) tests are conducted to determine if differences exist between the two counties. For the transportation attributes, Atascosa County coefficients do not jointly differ from Polk County at the 0.77 level. Inference from this test is that county residents generally respond the same to the transportation attributes. Socio-demographic variables' coefficients between the two counties, however, differed at the 0.00 level. The effect of socio-demographic variables on residents' transportation option decisions appear to differ between the two counties. Such differences are in line with the general notion that South Texas is different from the Piney Woods region. Respondents' average household income is higher for Atascosa than for Polk County. These differences may help explain variations in inferences associated with the socio-demographic variables between the two counties.

Some of the counties' socio-demographic variable coefficients do not have the expected significance or sign. From previous studies, it was expected the interaction between a respondent's age and whether or not they had children who lived over fifty miles away would positively affect their probability of choosing any public transportation option. This variable, however, is not positive or significant in the Atascosa County model. Although this variable has a positive coefficient for the Polk County resident models, it is only significant in the conditional logit model. As other examples, consider a respondent's age, experience with elderly transportation issues, and subjective probabilities which were expected to positively influence his/her decision to choose a transportation option. This, however, is not the case in all models. Most of these variables' coefficients are not significant in both Polk and Atascosa County

models. If the variable coefficient is significant, it is not always positive. For instance, in the conditional logit model the coefficient of the interaction variable between Choose and Age is significant to in both Atascosa and Polk Counties' models. The variable coefficient, however, is positive in the Atascosa County model and negative in the Polk County model; implying age affects the decisions of Polk and Atascosa county residents differently. These findings imply that while the influence of transportation attribute levels are consistent across counties, local input is important in customizing transportation systems to meet local expectations. More research is necessary in this area to determine what type of customization is preferred.

Comparison of Results between Students and County Residents

The purpose of including students in this study is to ensure the survey represented individuals who would be affected in the future by rural transportation updates. From the analysis, it became apparent that the student results, although similar to residents, may not represent the general public's opinions. Given the rising costs of conducting experimental and survey research, samples of convenience are normally used. For this reason, university students are often used in experimental economics. Students generally preferred the same transportation option attributes as the county residents. The magnitudes of the student WTP's, however, are generally higher than either of the county resident WTP's. From this observation the following question arises. "Are student WTP's similar enough to the general public's to be comparable enough for policy purposes or are student WTP's only relevant in experimental endeavors?" This study provides distributional comparisons which appear to support the conclusion that

students may not be similar enough to the general population to be used for policy analysis.

Mixed Logit versus Conditional Logit Estimation

In this research, the conditional and mixed logit models prove to be useful estimation tools; the following is a brief evaluation of the models' performances. The student conditional and mixed logit estimations were similar; both produced analogous variable coefficients. The county coefficient estimations, however, differed between the mixed and conditional logit models, specifically within the socio-demographic variables. The conditional logit models slightly outperformed the predictions of the mixed logit models in all three populations. The mixed logit models, however, are preferred to the conditional logit models because the random coefficients' standard errors (except for Flexible in the student mixed logit model) are statistically significant. Indicating the chosen random variables' coefficients vary between individuals in the sample.

Limitations and Future Research

One limitation to the applicability of this research is the response rate. The numbers of useable responses from Atascosa and Polk counties are lower than what was anticipated. Atascosa County had a 15% useable response rate, while Polk County had a 10% useable response rate. The low response rates can be attributed to several factors. First, issues with the mailing may have caused some questionnaire recipients to not respond. The surveys, for example, were mailed using bulk-rate mailing; it took much longer for residents to receive their questionnaire than what was anticipated. This meant many residents received their survey after the return-by date. One suggestion for future mail

surveys is to budget for first class mail postage to ensure respondents receive their questionnaires on time. Another issue was caused by the addressing the recipients' envelopes with a name rather than Resident. This action was expected to increase the response rate by making the mailing more personal. A name mix-up on the mailing labels in the first questionnaire mailing to Polk County, however, may have caused the response rate to be lower in that county.

One possible reason for the low response rate in Atascosa County could be because of the race / ethnicity make-up of the county. Previous studies suggest that there tends to be a lower response rate among minorities than whites (Griffin 2002; Johnson et al. 2002). The U.S. Census Bureau (2011) reports 62% of the Atascosa County population is Hispanic. Hispanic residents, however, only made up 39% of the survey respondents. If this survey were repeated, efforts to increase participation among Hispanics, may need to be implemented.

The last, and possibly most important, limitation to this study was the current economic and political climate. Although Texas did not suffer from the most recent recession as much as most of the U.S., county residents are aware of the toll the recession took on their own lives, the state, and the country. Views on the recession and examples of the conservative values of most Texans are displayed in the following responses:

“For the most part, the proposed additions to the annual registration fee was incredibly USURIUS and a total outrage! Clearly a pitch to fatten the state treasury at a DRACONIAN cost to its already bled dry citizens!”

“I only hope this isn't another government program. Lord knows we don't need that.”

“No thank you to more fees and taxes...”

“In these times of lost jobs, minimum wage jobs, and the threat of SS being cut, it would be hard for people to pay extra registration fees. The need is there, but the money is not.”

“...The questions unanswered seem to be an excuse for raising highway taxes. You are not fulfilling your job now. So no more taxes!!”

“Economy and Taxes have gone through the roof. My income is going backwards. Not the time.”

“I abhor a "socialistic" approach to problem solving. If seniors didn't save for their August years, shame on 'em.”

“I am sure that any system developed and administered by any level of government will evolve into a total "goat rope!!!"”

“The object is to decrease the size of government, not increase the size of government...”

“This will create another (*sic*) because of government that is not necessary. My family takes care of our own and while doing so we also take care of several other's needs as well, this includes taking them places.”

“I think the American public is taxed enough.”

Many non-useable responses came from respondents who expressed such views. One resident summed the situation up when he/she wrote, “In the future with economy changes, I might view this differently.” It would be interesting to see how each counties’ WTP’s change if the survey is repeated in a few years after the economy recovers from the most recent recession.

Another limitation is the county resident samples may not be representative of their respective populations. Resident respondents were randomly selected from addresses obtained from open record requests of the Atascosa and Polk County

Appraisal Districts. Using this source meant that only property owners were surveyed. A better sample would come from the Texas Department of Motor Vehicles (DMV). However, we were unable to obtain addresses from this source. If this survey were replicated in the future, a suggestion would be to develop a population sample from a source like the Department of Motor Vehicles. This would guarantee people who drive and pay vehicle registration fees are included in the sample.

Because the residents' WTP for transportation attributes is known, one suggestion for future research is to calculate how much it would cost to implement the preferred attribute levels. Using the available methodology, the fees which would be generated by each attribute level can be calculated. One limitation of the methodology, however, is that a cumulative WTP cannot be calculated. The WTP's for each transportation attribute level cannot be summed. The WTP's are based on changing the base attribute level to a different attribute level while holding all other attributes constant.

Considering there are approximately 14,500 registered vehicles in Atascosa County, using the mixed logit model results, the resident population's mean WTP would generate the following funds to implement these attribute levels over their respective base levels:

- 1) \$62,000 for Monday through Friday service over Monday, Wednesday, Friday service;
- 2) \$96,000 for seven day a week service over Monday, Wednesday, Friday service;

- 3) \$161,000 for 7AM to 5PM service over 7AM to 12 noon service;
- 4) \$197,000 for 8AM to 12AM service over 7AM to 12 noon service;
- 5) \$42,000 for a flexible route over a fixed route;
- 6) \$160,000 for a door-to-door route over a fixed route;
- 7) \$149,000 for a fifty percent discount on senior citizen fare over no discount for senior citizens; and
- 8) \$264,000 for a full senior citizen fare discount over no discount for senior citizens.

It is reiterated one cannot sum each attribute level WTP to obtain a total WTP. Many rural public transportation services already provide some form of flexible or door-to-door service. These services, however, are not usually available seven days a week or for extended hours. It would be worthwhile to compare the cost of providing these attributes to how much residents are willing to pay. Considering the cost of employees, vehicle maintenance, gasoline, etc., the total generated fees listed above may be small for implementing any change from the base. It, for example, would most likely cost more than \$96,000 to implement a seven day a week transportation service over the cost of the base Monday, Wednesday, Friday service for an entire county. It also seems implausible \$197,000 would cover the costs of implementing 8AM to midnight service (16 hours of service per day) over the base 7AM to noon service (4 hours of service per day) for an entire year.

Another recommendation for further research could come from comparing the WTP of students to the WTP of the general population. More research in this area

would provide useful inferences to help researchers utilize this easily accessible population.

REFERENCES

- Alsnih, R., and D. A. Hensher. 2003. The Mobility and Accessibility Expectations of Senior in an Aging Population. *Transportation Research Part A: Policy and Practice* 37(10): 903-916.
- Arcury, T., W. M. Gesler, J. S. Preisser, J. Sherman, J. Spencer, and J. Perin. 2005. The Effects of Geography and Spatial Behavior on Health Care Utilization among the Residents of a Rural Region. *Health Services Record* 40(1):135-155.
- Bailey, L. 2004. Aging Americans: Stranded Without Options. Washington DC: Surface Transportation Policy Project.
- Bockstael, N. E., W. M. Hanemann, and I. E. Strand. 1984. Measuring the Benefits of Water Quality Improvements Using Recreation Demand Models, Vol. II of Benefit Analysis Using Indirect or Imputed Market Methods, EPA Contract No. CR-811043-01-0.
- British Automobile Association. 1988. *Motoring and the Older Driver*. Basingstoke UK: British Automobile Association Foundation for Road Safety Research.
- Brown, D. 2008. *Public Transportation on the Move in Rural America*. Washington DC: U.S. Department of Agriculture, Economic Research Service.
- Brown, D., and E. S. Stommes. 2004. Rural Governments Face Public Transportation Challenges and Opportunities. *Amber Waves* 2(1): 11.
- Burns, P. 1999. Navigation and the Mobility of Older Drivers. *The Journals of Gerontology* 54B(1): S49-S55.
- Craig, B., and J. Busschbach. 2009. The Episodic Random Utility Model Unifies Time Trade-Off and Discrete Choice Approaches in Health State Valuation. *Population Health Metrics* 2009 7(3): 1-10
- Cromartie, J. 2006. Metropolitan Expansion and Nonmetro Change in the South. In W. Kandel, and D. Brown, eds. *The Population of Rural America: Demographic Research for a New Century*. New York: Springer, pp. 233-251.
- Cromartie, J., and P. Nelson. 2009. *Baby Boom Migration and Its Impact on Rural America*. Washington DC: U.S. Department of Agriculture, Economic Research Service, Economic Research Report Number 79: 15-18.

- Dellinger, A. M., J. A. Langlois, and G. Li. 2002. Fatal Crashes among Older Drivers: Decomposition of Rates Into Contributing Factors. *American Journal of Epidemiology* 155(3): 234-241.
- Dillman, D. A. 1991. The Design and Administration of Mail Surveys. *Annual Review of Sociology* 17: 225-249.
- Eschbach, K., M. Cline, L. Cherrington, and P. Ellis. 2010. *Estimated Impacts of the 2010 Census on the Texas Transit Funding Formula*. Texas Department of Transportation Project RMC 0-6199.
- Ezzati, M., A. B. Friedman, S. C. Kukarni, and C. J. L. Murray. 2008. The Reversal of Fortunes: Trends in County Mortality and Cross-County Mortality Disparities in the United States. *PLoS Med* 5(4): 0557-0568.
- Foster, N. S. J., P. C. Damiano, E. T. Momany, and H. T. McLeran. 1996. Rural Public Transportation: Perceptions of Transit Managers, Directors of Area Agencies on Aging, and Elders. *Transportation Research Record: Journal of the Transportation Research Board* 1557: 58-63.
- Frey, W. 1999. *Beyond Social Security: The Local Aspects of an Aging America*. Washington DC: The Brookings Institution Center on Urban and Metropolitan Policy.
- Glasgow, N., and R. M. Blakely. 2000. Older Nonmetropolitan Residents' Evaluations of Their Transportation Arrangements. *The Journal of Applied Gerontology* 19(1): 95-116.
- Gombeski Jr., W. R., and M. H. Smolensky. 1980. Non-Emergency Health Transportation Needs of the Rural Texas Elderly. *The Gerontologist* 20(4): 452-456.
- Grant, P. R., and B. Rice. 1983. Transportation Problems of the Rural Elderly: A Needs Assessment. *Canadian Journal on Aging* 2(3): 107-124.
- Greene, W. H. 2003. *Econometric Analysis*, 5th ed. New York: Pearson Education, Inc.
- Griffin, D. 2002. Measuring Survey Nonresponse by Race and Ethnicity. In Proceedings of the Annual Meetings of the American Statistical Association, 11-15 August.
- Hanemann, W. M. 1984. Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses. *American Journal of Agricultural Economics* 66: 332-341.

- Hanley, N., S. Mourato, and R. E. Wright. 2001. Choice Modeling Approaches: A Superior Alternative for Environmental Valuation? *Journal of Economic Surveys* 15(3): 435-462.
- He, W., M. Sengupta, V. A. Velkoff, and K. A. DeBarros. 2005. *65+ in the United States: 2005*. Washington DC: U.S. Census Bureau, Current Population Reports: 23-209.
- Hensher, D., and W. H. Greene. 2003. The Mixed Logit Model: The State of Practice. *Transportation* 30(2): 133-176.
- Horowitz, J. L. 1991. Modeling the Choice of Choice Set in Discrete Choice Random Utility Models. *Environment and Planning A* 23(9): 1237-46.
- Institute for Social Research. 2010. *Health and Retirement Survey*. Ann Arbor: University of Michigan. Available at <http://hrsonline.isr.umich.edu/>. Accessed Jan. 3, 2012.
- Johnson, T. P., D. O'Rourke, J. Burris, and L. Owens. 2002. Culture and Survey Nonresponse In: R. M. Groves, D. A. Dillman, J. L. Eltinge, and R. J. A. Little, eds. *Survey Nonresponse*. New York: Wiley, pp. 55-69.
- Kataria, M., I. Bateman, T. Christensen, A. Dubgaard, B. Hasler, S. Hime, J. Ladenburg, G. Levin, L. Martinsen, and C. Nissen. 2012. Scenario Realism and Welfare Estimates in Choice Experiments-A Non-Market Valuation Study on the European Water Framework Directive. *Journal of Environmental Management* 94(1): 25-33.
- Kim, S., and G. F. Ulfarsson. 2004. Travel Mode Choice of the Elderly: Effects of Personal, Household, Neighborhood, and Trip Characteristics. *Transportation Research Record: Journal of the Transportation Research Board* 1894: 117-126.
- Lee, C. K., and J. W. Mjelde. 2007. Valuation of Ecotourism Resources Using a Contingent Valuation Method: The Case of the Korean DMZ. *Ecological Economics* 63(2007): 511-520.
- Likert, R. 1932. A Technique for the Measurement of Attitudes. *Archives of Psychology* 140: 1-55.
- Lin, G. 1999. Assessing Changes in Interstate Migration Patterns of the United States Elderly Population, 1965-1990. *International Journal of Population Geography*, 5: 411-424.

- Mattson, J. 2010. *Transportation, Distance, and Health Care Utilization for Older Adults in Rural and Small Urban Areas*. Fargo ND: Upper Great Plains Transportation Institute, DP-236.
- Mattson, J. 2011. Aging and Mobility in Rural and Small Urban Areas: A Survey of North Dakota. *Journal of Applied Gerontology* 30(6): 700-718.
- McFadden, D. 1974. Conditional Logit Analysis of Qualitative Choice Behavior. In: P. Zarembka, ed. *Frontiers in Econometrics*. New York: Academic Press, pp. 105-142.
- McFadden, D. 1978. Modelling the Choice of Residential Location. In: A. Karlqvist, L. Lundqvist, F. Snickars, and J. Weibull, eds. *Spatial Interaction and Planning Models*. North Holland: Amsterdam, pp. 75-96.
- McFadden, D. 1981. Econometric Models of Probabilistic Choice Models. In: C. F. Manski, and D. McFadden, eds. *Structural Analysis of Discrete Data with Applications*. Cambridge: MIT Press, pp. 198-272.
- McGhee, J. L. 1983. Transportation Opportunity and the Rural Elderly: A Comparison of Objective and Subjective Indicators. *The Gerontologist* 23(5): 505-511.
- Middleton, E. 1991. Random Utility and the Preference for Variety. *Journal of Socio-Economics* 20(3): 227-233.
- Murray, C. J. L., S. C. Kulkarni, C. Michaud, N. Tomijima, M. T. Bulzacchelli, T. J. Iandiorio, and M. Ezzati. 2006. Eight Americas: Investigating Mortality Disparities across Races, Counties, and Race-Counties in the United States. *PLoS Medicine* 3(9): 1513-1524.
- National Highway Traffic Safety Administration. 1999. National Highway Traffic Safety Administration Publishes 1997 Statistics on Older Drivers. *Road Management and Engineering Journal*. Available at <http://www.usroads.com/journals/rmej/9903/rm990302.htm>. Accessed on February 20, 2012.
- Nelson, P., J. P. Nicholson, and E. H. Stege. 2004. The Baby Boom and Nonmetropolitan Population Change, 1975-1990. *Growth and Change* 35(4): 525-544.
- Olshansky, S. J., D. J. Passaro, R. C. Hershow, J. Layden, B. A. Carnes, J. Brody, L. Hayflick, R. N. Butler, D. B. Allison, and D. S. Ludwig. 2005. A Potential Decline in Life Expectancy in the United States in the 21st Century. *The New England Journal of Medicine* 352: 1138-1145.

- Parsons, G., and M. Kealy. 1992. Randomly Drawn Opportunity Sets in a Random Utility Model of Lake Recreation. *Land Economics* 68(1): 93-106.
- Pucher, J., and J. L. Renee. 2003. Socioeconomics of Urban Travel: Evidence from the 2001 NHTS. *Transportation Quarterly* 57(3): 49-77.
- Putnam, R. 1995. Bowling Alone: America's Declining Social Capital. *Journal of Democracy* 6(1): 65-78.
- Revis, J. S. 1971. *Transportation Background*. Presented at 1971 White House Conference on Aging, USGPO, Washington D.C.
- Robson, P. 1982. Patterns of Activity and Mobility Among the Elderly. *Geographical Perspectives on the Elderly*: 265-280.
- Rosenbloom, S. 1993. Women's Travel Patterns at Various Stages of Their Lives. In: C. Katz and J. Monk, eds. *Full Circles: Geographies of Women over the Life Course*. London: Routledge, pp. 208-242.
- Rosenbloom, S. 2004. The Mobility Needs of Older Americans. In: B. Katz and R. Puentes, eds. *Taking the High Road: A Transportation Agenda for Strengthening Metropolitan Areas*. Washington, D.C.: Brookings Press, pp. 227-256.
- Rosenbloom, S. 2009. Meeting Transportation Needs in an Aging-Friendly Community. *Generation* 33(2): 33-43.
- Rosenbloom, S., and S. Herbel. 2009. The Safety and Mobility Patterns of Older Women: Do Current Patterns Foretell the Future? *Public Works Management & Policy* 13(4): 338-353.
- Rubey, L., and F. Lupi. 1997. Predicting the Effects of Market Reform in Zimbabwe: A Stated Preference Approach. *American Journal of Agricultural Economics* 79(1): 89-99.
- Scarpa, R., T. J. Gilbride, D. Campbell, and D. A. Hensher. 2009. Modeling Attribute Non-Attendance in Choice Experiments for Rural Landscape Valuation. *European Review of Agricultural Economics* 36(2): 151-174.
- Skinner, D., and M. D. Stearns. 1999. Safe Mobility in an Aging World. In: *Annual Meeting of the Transportation Research Board*. Washington, D.C.
- Stommes, E., and D. Brown. 2002. Transportation in Rural America: Issues for the 21st Century. *Rural America* 16(4): 2-10.

- Sweeney, M. 2004. *Travel Patterns of Older Americans with Disabilities (Working paper No. 2004-001-OAS)*. Washington, D.C.: U.S. Department of Transportation, Bureau of Transportation Statistics.
- Talbot, D. M. 1985. Assessing the Needs of the Rural Elderly. *Journal of Gerontological Nursing* 11(3): 39-43.
- Texas State Demographer. 2008. Table 2 - Age, Sex and Race/Ethnicity (ASRE) Population by Migration Scenario by Age Group for 2000-2040 in 1 year increments: *Population Projections for the State of Texas*. Available at <http://txsdc.utsa.edu/tpepp/2008projections/>. Accessed on Feb. 8, 2011.
- Train, K. 2003. *Discrete Choice Methods with Simulation*. New York: Cambridge University Press.
- Transit Cooperative Research Program. 2009a. *Guidebook for Rural Demand-Response Transportation: Measuring, Assessing, and Improving Performance*. TCRP Report 136.
- Transit Cooperative Research Program. 2009b. Rural Transit Achievements: Assessing the Outcomes of Increased Funding for Rural Passenger Services under SAFETEA-LU. *Research Results Digest* 93.
- U.S. Census Bureau. 1986. *Intercensal Estimates of the Resident Population of the States 1970-1979*. Current Population Reports Series: 25-998.
- U.S. Census Bureau. 1993. *State Population Estimates by Age and Sex: 1980-1992*. Current Population Reports Series: 25-1106.
- U.S. Census Bureau. 2000a. *1990 to 1999 Annual Time Series of State Population Estimates by Single Year of Age and Sex*. Available at http://www.census.gov/popest/archives/1990s/st_age_sex.html. Accessed on Feb. 8, 2011.
- U.S. Census Bureau. 2000b. *Table DP-1. Profile of General Demographic Characteristics: 2000, Geographic area: Atascosa County, Texas*. Available at <http://censtats.census.gov/data/TX/05048013.pdf>. Accessed on Jan. 2, 2012.
- U.S. Census Bureau. 2000c. *Table DP-1. Profile of General Demographic Characteristics: 2000, Geographic area: Polk County, Texas*. Available at <http://censtats.census.gov/data/TX/05048373.pdf>. Accessed on Jan. 2, 2012.

- U.S. Census Bureau. 2006. *Selected Characteristics of Baby Boomers 42 to 60 Years Old in 2006*. Available at <http://www.census.gov/population/www/socdemo/age/2006%20Baby%20Boomers.pdf>. Accessed on Jan. 29, 2011.
- U.S. Census Bureau. 2008. *National Population Projections - Projections of the Population by Sex, Race, and Hispanic Origin for the United States: 2010 to 2050*. Available at <http://www.census.gov/population/www/projections/summarytables.html>. Accessed on Jan. 24, 2011.
- U.S. Census Bureau. 2009. *State Single Year of Age and Sex Population Estimates: April 1, 2000-July 1, 2009 (Civilian)*. Available at <http://www.census.gov/popest/states/asrh/stasrh.html>. Accessed on Feb. 8, 2011.
- U.S. Census Bureau. 2010a. *2005-2009 American Community Survey 5-Year Estimates*. Available at http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=Atascosa&_cityTown=Atascosa&_state=04000US48&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010. Accessed on May. 24, 2011
- U.S. Census Bureau. 2010b. *2005-2009 American Community Survey 5-Year Estimates, Atascosa County, TX*. Available at http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&geo_id=&_geoContext=&_street=&_county=Atascosa&_cityTown=Atascosa&_state=04000US48&_zip=&_lang=en&_sse=on&pctxt=fph&pgsl=010. Accessed on Jan. 2, 2012.
- U.S. Census Bureau. 2010c. *2005-2009 American Community Survey 5-Year Estimates, Polk County, TX*. Available at http://factfinder.census.gov/servlet/ACSSAFFFacts?_event=Search&geo_id=05000US48013&_geoContext=01000US%7C04000US48%7C05000US48013&_street=&_county=Polk&_cityTown=Polk&_state=04000US48&_zip=&_lang=en&_sse=on&ActiveGeoDiv=geoSelect&_useEV=&pctxt=fph&pgsl=050&_submenuId=factsheet_1&ds_name=ACS_2009_5YR_SAFF&_ci_nbr=null&qr_name=null®=null%3Anull&_keyword=&_industry=. Accessed on Jan. 2, 2012.
- U.S. Census Bureau. 2010d. *American FactFinder: Atascosa County, TX*. Available at http://factfinder2.census.gov/faces/tables/services/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1&prodType=table. Accessed on Jan. 2, 2012.

- U.S. Census Bureau. 2010e. *American FactFinder: Polk County, TX*. Available at http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1&prodType=table. Accessed on Jan. 2, 2012.
- U.S. Census Bureau. 2011. 2008-2010 *American Community Survey 3-Year Estimates, Selected Economic Characteristics, DP3*. Available at <http://factfinder2.census.gov/>. Accessed on Jan. 3, 2012.
- U.S. Department of Agriculture. 2007. *Nonmetro America Faces Challenges From an Aging Population*. Economic Research Service, Briefing Rooms.
- Wallace, R., P. Hughes-Cromwick, H. Mull, and S. Khasnabis. 2005. Access to Health Care and Nonemergency Medical Transportation: Two Missing Links. *Transportation Research Record, Journal of the Transportation Research Board* 1924: 76-84.
- Wallace, R., P. Hughes-Cromwick, and H. Mull. 2006. Cost Effectiveness of Access to Nonemergency Medical Transportation: Comparison of Transportation and Health Care Costs and Benefits. *Transportation Research Record, Journal of the Transportation Research Board* 1956: 86-93.
- Wolter, K. M. 2007. *Introduction to Variance Estimation*, 2nd ed. S. E. Feinberg, and W. J. van der Linden, eds. New York: Springer.

APPENDIX A

TABLES

Table 3. Demographic Characteristics - Student

| | Number of Respondents | Frequency | Percent |
|-------------------------------|--------------------------|-----------|---------|
| Qualitative Characteristics | | | |
| College Enrolled | 434 | | |
| Agriculture and Life Sciences | | 284 | 65.44 |
| Architecture | | 2 | 0.46 |
| Veterinary Science | | 2 | 0.46 |
| Science | | 5 | 1.15 |
| Business | | 12 | 2.76 |
| Engineering | | 21 | 4.84 |
| Liberal Arts | | 44 | 10.14 |
| Education | | 36 | 8.29 |
| Geosciences | | 3 | 0.69 |
| General Studies | | 13 | 3.00 |
| Other | | 12 | 2.76 |
| Classification | 434 | | |
| Freshman | | 35 | 8.06 |
| Sophomore | | 64 | 14.75 |
| Junior | | 178 | 41.01 |
| Senior | | 153 | 35.25 |
| Other | | 4 | 0.92 |
| Marital Status | 434 | | |
| Single | | 410 | 94.47 |
| Married | | 12 | 2.77 |
| Other | | 12 | 2.77 |
| Race | | | |
| White | 434 | 352 | 81.11 |
| Hispanic | | 57 | 13.13 |
| African American/Black | | 14 | 3.23 |
| Asian/Pacific Islander | | 6 | 1.38 |
| Multicultural | | 2 | 0.46 |
| Other | | 3 | 0.69 |

Table 3 continued

| | Number of Respondents | Frequency | Percent |
|---|--------------------------|-----------|-----------------------|
| Gender | 434 | | |
| Male | | 209 | 48.16 |
| Female | | 225 | 51.84 |
| Funding Support | 434 | | |
| Majority Parent/Guardian Funded | | 219 | 50.46 |
| Majority Self Funded | | 215 | 49.54 |
| Description of the area where house in home town is located | 434 | | |
| Inside city or town limits | | 244 | 56.22 |
| Outside city limits | | 190 | 43.78 |
| Voting History | 434 | | |
| Voted in the last national, state, or local election | | 245 | 56.45 |
| Did not vote | | 189 | 43.55 |
| Knew about public transportation options in his/her home town | 434 | | |
| Yes, knew about options | | 230 | 53 |
| No, did not know about options | | 204 | 47 |
| Quantitative Characteristics | | | |
| | Number of Respondents | Mean | Standard Deviation |
| Age (year) | 434 | 21.09 | 2.19 |
| The percent chance that the respondent will live to be 75, or older | 434 | 78.27 | 23.22 |
| The percent chance the respondent will live in a rural town or in the country when over the age of 75 | 434 | 56.91 | 33.61 |
| The percent chance that when over 75 the respondent will use alternative forms of transportation | 434 | 50.16 | 29.62 |

Table 4. Likert Scale Responses - Student

| Questions | 1 | 2 | 3 | 4 | 5 |
|--|-----|----|-----|-----|-----|
| Questions concerning familiarity with hometown public transportation options ^a | | | | | |
| Number of Respondents | 231 | | | | |
| The type of public transportation options available | 54 | 45 | 58 | 58 | 16 |
| The service area of the public transportation option | 86 | 46 | 58 | 30 | 11 |
| How to schedule a trip within the service area | 118 | 50 | 34 | 22 | 7 |
| The fare for a one-way trip | 143 | 45 | 24 | 10 | 9 |
| The availability of public transportation for senior citizens | 130 | 54 | 28 | 15 | 4 |
| Questions concerning how important for drivers of public transportation vehicles to have the following ^b | | | | | |
| Number of Respondents | 428 | | | | |
| Passing a background check | 3 | 8 | 36 | 147 | 234 |
| Advanced first aid training | 4 | 15 | 59 | 169 | 181 |
| Cardiopulmonary Resuscitation (CPR) training | 4 | 16 | 47 | 154 | 207 |
| To the respondents knowledge how have age related disabilities affected the driving ability of the following people ^c | | | | | |
| Number of Respondents | 434 | | | | |
| Elderly family members | 34 | 64 | 159 | 89 | 88 |
| Elderly friends | 32 | 60 | 176 | 101 | 65 |

^a1 = Not Familiar, 3 = Neutral, 5 = Very Familiar

^b1= Not Important, 3 = Neutral, 5 = Extremely Important

^c1 = Little to No Difficulty, 3 = Some Difficulty, 5 = Limited Driving Ability

Table 5. Variables used in Logit Models - Student

| Name | Description |
|---------------------------|---|
| Qualitative Variables | |
| M-F ^a | 1, if transportation option operates Monday – Friday, 0 otherwise |
| Seven ^a | 1, if transportation option operates seven days a week, 0 otherwise |
| 7AM to 5PM ^b | 1, if transportation option operates 7AM to 5PM, 0 otherwise |
| 8AM to 12AM ^b | 1, if transportation option operates 8AM to 12AM, 0 otherwise |
| Flexible ^c | 1, if transportation option has flexible-route service, 0 otherwise |
| Door-to-door ^c | 1, if transportation option has door-to-door service, 0 otherwise |
| Fifty ^d | 1, if transportation option has 50% discount for senior citizens, 0 otherwise |
| Free ^d | 1, if transportation option is free for senior citizens, 0 otherwise |
| Choose | 1, if respondent chose a transportation option (Option A or Option B), 0 if the respondent did not choose a transportation option |
| Male | 1, if respondent was a male, 0 otherwise |
| White | 1, if respondent's ethnicity was white, 0 otherwise |
| Dfund | 1, if the majority of the respondent's funding came from their parents, 0 otherwise |
| City | 1, if the respondent's home was located within the city limits, 0 otherwise |
| Rural ^e | 1, if the respondents' home county was classified as 'rural', 0 otherwise |
| Voted | 1, if the respondent voted in their most recent national, state, or local election, 0 otherwise |
| Aware Public Transit | 1, if the respondent was not aware of their home county's public transportation system, 0 otherwise |
| Continuous Variables | |
| Fee | The additional registration fee (\$/year), entered as a positive value |
| Age | The respondent's age (years) |
| Old | The probability (0%-100%) that the respondent believes he/she will live to be 75 |
| Country | The probability (0%-100%) that the respondent believes he/she will live in the country if he/she lives to be over the age of 75 |

Table 5 continued

| Name | Description |
|-------------------------|--|
| Transport | The probability (0%-100%) that the respondent believes he/she will use alternative forms of transportation if he/she lives to be over the age of 75 |
| Experience ^f | A number between 2 and 10 which indicates the amount of the experience that the respondent has with elderly individuals who have transportation issues |

^a Monday, Wednesday, Friday (MWF) used as base in models.

^b 7AM to 12PM (7AM-12PM) used as base in models .

^c Fixed Route (Fixed) used as base in models.

^d No senior citizen discount (Full) used as base in models.

^e A respondent's home county was classified as rural if the county employed a rural transit system as specified in Eschbach et al. (2010)

^f This variable was acquired by summing the respondent's answers to the Likert scale question determining their knowledge of elderly transportation issues (table 4).

Table 6. Conditional Logit Model Results - Student

| Variable | Coefficient | Standard Error | z | P > z | Fee Premium (\$/Year) |
|--|-------------|----------------|--------|--------|-----------------------|
| Fee (\$/year) | -0.0344 | 0.0034 | -10.08 | 0.000 | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.4603 | 0.0738 | 6.23 | 0.000 | \$13.45 |
| Seven | 0.8486 | 0.0740 | 11.46 | 0.000 | \$24.79 |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 0.7947 | 0.0737 | 10.79 | 0.000 | \$23.22 |
| 8AM to 12AM | 0.7868 | 0.0744 | 10.57 | 0.000 | \$22.99 |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.2949 | 0.0721 | 4.09 | 0.000 | \$8.62 |
| Door-to-door | 0.6183 | 0.0734 | 6.14 | 0.000 | \$13.17 |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.6183 | 0.0735 | 8.42 | 0.000 | \$18.07 |
| Free | 0.7759 | 0.0727 | 10.68 | 0.000 | \$22.67 |
| Qualitative interaction variables | | | | | |
| Choose*Male | -0.0975 | 0.1451 | -0.67 | 0.502 | |
| Choose *White | 1.1148 | 0.1685 | 6.61 | 0.000 | |
| Choose *Dfund | -0.2863 | 0.1436 | -1.99 | 0.046 | |
| Choose *Rural | -0.4828 | 0.1595 | -3.03 | 0.002 | |
| Choose *City | -0.3846 | 0.1628 | -2.36 | 0.018 | |
| Choose *Voted | -0.1911 | 0.1428 | -1.34 | 0.181 | |
| Choose * Aware Public Transit | -0.0544 | 0.1455 | -0.37 | 0.709 | |
| Continuous interaction variables | | | | | |
| Choose *Age | -0.2863 | 0.1436 | -1.99 | 0.046 | |
| Choose *Old | 0.0033 | 0.0027 | 1.21 | 0.226 | |
| Choose *Country | -0.0072 | 0.0023 | -3.11 | 0.002 | |
| Choose *Transport | 0.0114 | 0.0025 | 4.57 | 0.000 | |
| Choose *Experience | 0.0956 | 0.0329 | 2.91 | 0.004 | |

Table 7. Mixed Logit Model Results - Student

| Variable | Coefficient | Standard Error | z | P > z | Fee Premium (\$/Year) |
|---|-------------|----------------|--------|--------|-----------------------|
| Fee (\$/year) | -0.0525 | 0.0052 | -10.10 | 0.000 | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.7071 | 0.1166 | 6.07 | 0.000 | \$13.46 |
| Seven | 1.2663 | 0.1255 | 10.09 | 0.000 | \$24.10 |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 1.2373 | 0.1231 | 10.05 | 0.000 | \$23.55 |
| 8AM to 12AM | 1.1989 | 0.1337 | 8.97 | 0.000 | \$22.82 |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.3567 | 0.1053 | 3.39 | 0.001 | \$6.79 |
| Door-to-door | 0.6407 | 0.1293 | 4.96 | 0.000 | \$12.19 |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.9276 | 0.1158 | 8.01 | 0.000 | \$17.66 |
| Free | 1.1756 | 0.1178 | 9.98 | 0.000 | \$22.37 |
| Qualitative interaction variables | | | | | |
| Choose*Male | -0.0970 | 0.1814 | -0.53 | 0.593 | |
| Choose *White | 1.0364 | 0.2169 | 4.78 | 0.000 | |
| Choose *Dfund | -0.2399 | 0.1752 | -1.37 | 0.171 | |
| Choose *Rural | -0.6032 | 0.2001 | -3.01 | 0.003 | |
| Choose *City | -0.3586 | 0.2068 | -1.73 | 0.083 | |
| Choose *Voted | -0.2128 | 0.1782 | -1.19 | 0.232 | |
| Choose * Aware Public Transit | -0.1493 | 0.1794 | -0.83 | 0.405 | |
| Continuous interaction variables | | | | | |
| Choose *Age | -0.0162 | 0.0221 | -0.73 | 0.464 | |
| Choose *Old | .00003 | 0.0034 | 0.10 | 0.921 | |
| Choose *Country | -0.0083 | 0.0029 | -2.85 | 0.004 | |
| Choose *Transport | 0.0102 | 0.0031 | 3.30 | 0.001 | |
| Choose *Experience | 0.0869 | 0.0420 | 2.07 | 0.039 | |
| Standard Deviations of Variables with Random Coefficients | | | | | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.9125 | 0.1627 | 5.61 | 0.000 | |
| Seven | 1.1370 | 0.1770 | 6.42 | 0.000 | |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 0.9971 | 0.1844 | 5.41 | 0.000 | |
| 8AM to 12AM | 1.3732 | 0.1701 | 8.08 | 0.000 | |

Table 7 continued

| Variable | Coefficient | Standard Error | z | P > z | Fee Premium (\$/Year) |
|--|-------------|----------------|------|--------|-----------------------|
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.4794 | 0.3277 | 1.46 | 0.144 | |
| Door-to-door | 1.5377 | 0.1776 | 8.66 | 0.000 | |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.8365 | 0.1829 | 4.57 | 0.000 | |
| Free | 0.8488 | 0.1769 | 4.80 | 0.000 | |

Table 8. Summary Statistics for Conditional and Mixed Logit Models - Student

| Summary Statistics | Conditional Logit | Mixed Logit |
|--------------------------------------|-------------------|-------------|
| Number of Observations | 7782 | 7782 |
| Cluster (Number of Respondents) | 433 | 433 |
| McFadden's R^2 | 0.178 | |
| Akaike Information Criterion (AIC) | 7023.542 | 4283.139 |
| Bayesian Information Criterion (BIC) | 7169.693 | 4484.966 |
| Percent Correct Predictions | 62.41% | 62.03% |

Table 9. Chi-Squared Hypothesis Tests - Student

| Null Hypothesis | $\chi^2 (1)$ | $P > \chi^2 $ |
|-------------------|--------------|----------------|
| Conditional Logit | | |
| | 29.29 | 0.0000 |
| | 0.01 | 0.9112 |
| | 4.52 | 0.0335 |
| | 4.74 | 0.0295 |
| Mixed Logit | | |
| | 19.64 | 0.0000 |
| | 0.08 | 0.7743 |
| | 4.64 | 0.0312 |
| | 4.38 | 0.0364 |

Table 10. Demographic Characteristics - Atascosa County

| | Number of Respondents | Frequency | Percent |
|---|--------------------------|-----------|---------|
| Qualitative Characteristics | | | |
| Level of Education | 235 | | |
| Less than 12 th grade | | 16 | 6.81 |
| High school diploma or GED | | 67 | 28.51 |
| Some college, no degree | | 56 | 23.83 |
| Associate's degree | | 14 | 5.96 |
| Bachelor's degree | | 45 | 19.15 |
| Graduate and/or professional school | | 37 | 15.74 |
| Before-tax household income | 235 | | |
| Less than \$10,000 | | 7 | 2.98 |
| \$10,000 to \$24,999 | | 36 | 15.32 |
| \$25,000 to \$49,999 | | 67 | 28.51 |
| \$50,000 to \$74,999 | | 51 | 21.70 |
| \$75,000 to \$99,999 | | 34 | 14.47 |
| \$100,000 or more | | 40 | 17.02 |
| Marital Status | 235 | | |
| Single | | 17 | 7.23 |
| Married | | 173 | 73.62 |
| Separated or Divorced | | 28 | 11.91 |
| Widowed | | 17 | 7.23 |
| Race | | | |
| White | 235 | 137 | 58.30 |
| Hispanic | | 92 | 39.15 |
| African American/Black | | 0 | 0.00 |
| Multiracial | | 1 | 0.43 |
| Other | | 5 | 2.13 |
| Gender | 235 | | |
| Male | | 135 | 57.45 |
| Female | | 100 | 42.55 |
| Description of the area where house in home town is located | 235 | | |
| Inside city or town limits | | 106 | 45.11 |
| Outside city limits | | 129 | 54.89 |
| Voting History | 235 | | |
| Voted in the last national, state, or local election | | 196 | 83.40 |

Table 10 continued

| | Number of Respondents | Frequency | Percent |
|---|--------------------------|-----------|-----------------------|
| Did not vote | | 39 | 16.60 |
| Knew about public transportation options in his/her home town | 235 | | |
| Yes, knew about options | | 78 | 33.19 |
| No, did not know about options | | 157 | 66.81 |
| Quantitative Characteristics | | | |
| | Number of Respondents | Mean | Standard Deviation |
| Age (year) | 235 | 56.56 | 10.83 |
| The percent chance that the respondent will live to be 75, or older | 235 | 77.03 | 24.71 |
| The percent chance the respondent will live in a rural town or in the country when over the age of 75 | 235 | 80.67 | 30.01 |
| The percent chance that when over 75 the respondent will use alternative forms of transportation | 235 | 57.01 | 32.58 |

Table 11. Likert Scale Responses - Atascosa County

| Questions | 1 | 2 | 3 | 4 | 5 |
|--|-----|----|----|----|-----|
| Questions concerning familiarity with hometown public transportation options ^a | | | | | |
| Number of Respondents | 78 | | | | |
| The type of public transportation options available | 36 | 17 | 18 | 6 | 1 |
| The service area of the public transportation option | 46 | 13 | 15 | 2 | 2 |
| How to schedule a trip within the service area | 54 | 11 | 9 | 2 | 2 |
| The fare for a one-way trip | 56 | 9 | 10 | 2 | 1 |
| The availability of public transportation for senior citizens | 50 | 9 | 16 | 2 | 1 |
| Questions concerning how important for drivers of public transportation vehicles to have the following ^b | | | | | |
| Number of Respondents | 233 | | | | |
| Passing a background check | 5 | 0 | 4 | 24 | 200 |
| Advanced first aid training | 2 | 0 | 20 | 50 | 161 |
| Cardiopulmonary Resuscitation (CPR) training | 2 | 0 | 16 | 45 | 170 |
| Disability equipment training | 2 | 1 | 19 | 51 | 160 |
| Be multilingual | 19 | 6 | 69 | 40 | 98 |
| To the respondents knowledge how have age related disabilities affected the driving ability of the following people ^c | | | | | |
| Number of Respondents | 235 | | | | |
| Elderly family members | 54 | 26 | 70 | 20 | 65 |
| Elderly friends | 49 | 29 | 74 | 34 | 49 |

^a1 = Not Familiar, 3 = Neutral, 5 = Very Familiar

^b1 = Not Important, 3 = Neutral, 5 = Extremely Important

^c1 = Little to No Difficulty, 3 = Some Difficulty, 5 = Limited Driving Ability

Table 12. Demographic Characteristics - Polk County

| | Number of Respondents | Frequency | Percent |
|---|--------------------------|-----------|---------|
| Qualitative Characteristics | | | |
| Level of Education | 163 | | |
| Less than 12 th grade | | 8 | 4.91 |
| High school diploma or GED | | 31 | 19.02 |
| Some college, no degree | | 55 | 33.74 |
| Associate's degree | | 11 | 6.75 |
| Bachelor's degree | | 30 | 18.40 |
| Graduate and/or professional school | | 28 | 17.18 |
| Before-tax household income | 163 | | |
| Less than \$10,000 | | 6 | 3.68 |
| \$10,000 to \$24,999 | | 36 | 22.09 |
| \$25,000 to \$49,999 | | 39 | 23.93 |
| \$50,000 to \$74,999 | | 37 | 22.70 |
| \$75,000 to \$99,999 | | 23 | 14.11 |
| \$100,000 or more | | 22 | 13.50 |
| Marital Status | 163 | | |
| Single | | 11 | 6.75 |
| Married | | 117 | 71.78 |
| Separated or Divorced | | 15 | 9.20 |
| Widowed | | 20 | 12.27 |
| Race | | | |
| White | 163 | 149 | 91.41 |
| Hispanic | | 4 | 2.45 |
| African American/Black | | 7 | 4.29 |
| Multiracial | | 0 | 0.00 |
| Other | | 3 | 1.84 |
| Gender | 163 | | |
| Male | | 78 | 47.85 |
| Female | | 85 | 52.15 |
| Description of the area where house in home town is located | 163 | | |
| Inside city or town limits | | 23 | 14.11 |
| Outside city limits | | 140 | 85.89 |
| Voting History | 163 | | |
| Voted in the last national, state, or local election | | 143 | 87.73 |

Table 12 continued

| | Number of Respondents | Frequency | Percent |
|---|--------------------------|-----------|-----------------------|
| Did not vote | | 20 | 12.27 |
| Knew about public transportation options in his/her home town | 163 | | |
| Yes, knew about options | | 62 | 38.04 |
| No, did not know about options | | 101 | 61.96 |
| Quantitative Characteristics | | | |
| | Number of Respondents | Mean | Standard Deviation |
| Age (year) | 163 | 60.10 | 10.35 |
| The percent chance that the respondent will live to be 75, or older | 163 | 78.26 | 24.71 |
| The percent chance the respondent will live in a rural town or in the country when over the age of 75 | 163 | 84.08 | 27.48 |
| The percent chance that when over 75 the respondent will use alternative forms of transportation | 163 | 62.50 | 29.82 |

Table 13. Likert Scale Responses - Polk County

| Questions | 1 | 2 | 3 | 4 | 5 |
|--|-----|----|----|----|-----|
| Questions concerning familiarity with hometown public transportation options ^a | | | | | |
| Number of Respondents | 63 | | | | |
| The type of public transportation options available | 21 | 11 | 12 | 10 | 9 |
| The service area of the public transportation option | 29 | 12 | 4 | 13 | 4 |
| How to schedule a trip within the service area | 31 | 14 | 4 | 6 | 8 |
| The fare for a one-way trip | 38 | 11 | 4 | 4 | 6 |
| The availability of public transportation for senior citizens | 28 | 15 | 4 | 11 | 5 |
| Questions concerning how important for drivers of public transportation vehicles to have the following ^b | | | | | |
| Number of Respondents | 161 | | | | |
| Passing a background check | 3 | 1 | 4 | 23 | 130 |
| Advanced first aid training | 4 | 3 | 26 | 38 | 90 |
| Cardiopulmonary Resuscitation (CPR) training | 4 | 3 | 22 | 30 | 101 |
| Disability equipment training | 3 | 3 | 21 | 32 | 101 |
| Be multilingual | 42 | 25 | 50 | 16 | 27 |
| To the respondents knowledge how have age related disabilities affected the driving ability of the following people ^c | | | | | |
| Number of Respondents | 163 | | | | |
| Elderly family members | 45 | 19 | 41 | 14 | 44 |
| Elderly friends | 28 | 20 | 54 | 22 | 39 |

^a1 = Not Familiar, 3 = Neutral, 5 = Very Familiar

^b1= Not Important, 3 = Neutral, 5 = Extremely Important

^c1 = Little to No Difficulty, 3 = Some Difficulty, 5 = Limited Driving Ability

Table 14. Variables used in Logit Models - Atascosa and Polk Counties

| Name | Description |
|---------------------------|---|
| Qualitative Variables | |
| M-F ^a | 1, if transportation option operates Monday – Friday, 0 otherwise |
| Seven ^a | 1, if transportation option operates seven days a week, 0 otherwise |
| 7AM to 5PM ^b | 1, if transportation option operates 7AM to 5PM, 0 otherwise |
| 8AM to 12AM ^b | 1, if transportation option operates 8AM to 12AM, 0 otherwise |
| Flexible ^c | 1, if transportation option has flexible-route service, 0 otherwise |
| Door-to-door ^c | 1, if transportation option has door-to-door service, 0 otherwise |
| Fifty ^d | 1, if transportation option has 50% discount for senior citizens, 0 otherwise |
| Free ^d | 1, if transportation option is free for senior citizens, 0 otherwise |
| Choose | 1, if respondent chose a transportation option (Option A or Option B), 0 if the respondent did not choose a transportation option |
| Male | 1, if respondent was a male, 0 otherwise |
| White | 1, if respondent's ethnicity was white, 0 otherwise |
| Single | 1, if the respondent was single, divorced, or separated, 0 otherwise |
| Income_2 | 1, if the respondent's before-tax household income was between \$25,000 and \$49,999, 0 otherwise |
| Income_3 | 1, if the respondent's before-tax household income was between \$50,000 and \$74,999, 0 otherwise |
| Income_4 | 1, if the respondent's before-tax household income was more than \$75,000, 0 otherwise |
| College | 1, if the respondent attended college, 0 otherwise |
| Only Far Children | 1, if the respondent's children live more than 51 miles away from the respondent's home, 0 otherwise |
| City | 1, if the respondent's home was located within the city limits, 0 otherwise |
| Voted | 1, if the respondent voted in their most recent national, state, or local election, 0 otherwise |
| Aware Public Transit | 1, if the respondent was not aware of their home county's public transportation system, 0 otherwise |
| Continuous Variables | |

Table 14 continued

| Name | Description |
|-------------------------|--|
| Fee | The additional registration fee (\$/year), entered as a positive value |
| Age | The respondent's age (years) |
| Old | The probability (0%-100%) that the respondent believes he/she will live to be 75 |
| Country | The probability (0%-100%) that the respondent believes he/she will live in the country if he/she lives to be over the age of 75 |
| Transport | The probability (0%-100%) that the respondent believes he/she will use alternative forms of transportation if he/she lives to be over the age of 75 |
| Experience ^e | A number between 2 and 10 which indicates the amount of the experience that the respondent has with elderly individuals who have transportation issues |

^a Monday, Wednesday, Friday (MWF) used as base in models.

^b 7AM to 12PM (7AM-12PM) used as base in models .

^c Fixed Route (Fixed) used as base in models.

^d No senior citizen discount (Full) used as base in models.

^e This variable was acquired by summing the respondent's answers to the Likert scale question determining their knowledge of elderly transportation issues (tables 11 and 13).

Table 15. Conditional Logit Model Results - Atascosa County

| Variable | Coefficient | Standard Error | Z | P > z | WTP (\$/Year) |
|--|-------------|----------------|-------|--------|---------------|
| Fee (\$/year) | -0.0491 | 0.0052 | -9.38 | 0.000 | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.2923 | 0.1098 | 2.66 | 0.008 | 5.96 |
| Seven | 0.3750 | 0.1082 | 3.47 | 0.001 | 7.65 |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 0.6384 | 0.1108 | 5.76 | 0.000 | 13.01 |
| 8AM to 12AM | 0.7306 | 0.1112 | 6.57 | 0.000 | 14.89 |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.1683 | 0.1126 | 1.49 | 0.135 | 3.43 |
| Door-to-door | 0.7061 | 0.1090 | 6.48 | 0.000 | 14.40 |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.6384 | 0.1128 | 5.66 | 0.000 | 13.01 |
| Free | 0.9480 | 0.1124 | 8.43 | 0.000 | 19.33 |
| Qualitative interaction variables | | | | | |
| Choose*Male | -0.2175 | 0.1637 | -1.33 | 0.184 | |
| Choose *White | 0.2564 | 0.1609 | 1.59 | 0.111 | |
| Choose *Single | 1.9717 | 0.3573 | 5.52 | 0.000 | |
| Choose *Income_2 | 0.4630 | 0.2238 | 2.07 | 0.039 | |
| Choose *Income_3 | 1.2849 | 0.2473 | 5.20 | 0.000 | |
| Choose *Income_4 | 1.1205 | 0.2461 | 4.55 | 0.000 | |
| Choose *College | -0.3807 | 0.1839 | -2.07 | 0.038 | |
| Choose*Only Far Children | 0.2541 | 2.9728 | 0.12 | 0.902 | |
| Choose*Only Far Children*Age | -0.0160 | 0.0350 | -0.46 | 0.647 | |
| Choose *City | 1.1146 | 0.1561 | 7.14 | 0.000 | |
| Choose *Voted | -0.3404 | 0.2160 | -1.58 | 0.115 | |
| Choose * Aware Public Transit | 0.2586 | 0.1658 | 1.56 | 0.119 | |
| Continuous interaction variables | | | | | |
| Choose *Age | -0.0307 | 0.0062 | -4.98 | 0.000 | |
| Choose *Old | -0.0026 | 0.0035 | -0.75 | 0.451 | |
| Choose *Country | -0.0010 | 0.0029 | -3.40 | 0.001 | |
| Choose *Transport | 0.0068 | 0.0024 | 2.81 | 0.005 | |
| Choose *Experience | 0.0878 | 0.0293 | 3.00 | 0.003 | |

Table 16. Mixed Logit Model Results - Atascosa County

| Variable | Coefficient | Standard Error | z | P > z | WTP (\$/Year) |
|--|-------------|----------------|-------|--------|---------------|
| Fee (\$/year) | -0.0879 | 0.0089 | -9.84 | 0.000 | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.3752 | 0.2147 | 1.75 | 0.081 | 4.27 |
| Seven | 0.5794 | 0.1887 | 3.07 | 0.002 | 6.59 |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 0.9878 | 0.1989 | 4.92 | 0.000 | 11.13 |
| 8AM to 12AM | 1.1913 | 0.2250 | 5.30 | 0.000 | 13.56 |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.2519 | 0.1870 | 1.35 | 0.178 | 2.87 |
| Door-to-door | 0.9667 | 0.2214 | 4.37 | 0.000 | 11.00 |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.9043 | 0.1887 | 4.79 | 0.000 | 10.29 |
| Free | 1.5978 | 0.2055 | 7.77 | 0.000 | 18.18 |
| Qualitative interaction variables | | | | | |
| Choose*Male | -0.1871 | 0.2561 | -0.73 | 0.465 | |
| Choose *White | 0.1599 | 0.2528 | 0.63 | 0.527 | |
| Choose *Single | 2.1243 | 0.4779 | 4.45 | 0.000 | |
| Choose *Income_2 | 0.1968 | 0.3419 | 0.58 | 0.565 | |
| Choose *Income_3 | 0.9402 | 0.3928 | 2.39 | 0.017 | |
| Choose *Income_4 | 1.0426 | 0.3906 | 2.67 | 0.008 | |
| Choose *College | -0.2564 | 0.2858 | -0.90 | 0.370 | |
| Choose*Only Far Children | 1.9439 | 3.4596 | 0.56 | 0.574 | |
| Choose*Only Far Children*Age | -0.0451 | 0.0588 | -0.77 | 0.443 | |
| Choose *City | 1.2229 | 0.2505 | 4.88 | 0.000 | |
| Choose *Voted | -0.7159 | 0.3360 | -2.13 | 0.033 | |
| Choose * Aware Public Transit | 0.5273 | 0.2724 | 1.94 | 0.053 | |
| Continuous interaction variables | | | | | |
| Choose *Age | -0.0294 | 0.0094 | -3.11 | 0.002 | |
| Choose *Old | -0.0036 | 0.0054 | -0.67 | 0.504 | |
| Choose *Country | -0.0066 | 0.0044 | -1.51 | 0.131 | |
| Choose *Transport | 0.0056 | 0.0037 | 1.52 | 0.129 | |
| Choose *Experience | 0.0813 | 0.0438 | 1.85 | 0.064 | |

Table 16 continued

| Variable | Coefficient | Standard Error | z | P > z | WTP (\$/Year) |
|---|-------------|----------------|------|--------|---------------|
| Standard Deviations of Variables with Random Coefficients | | | | | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 1.6009 | 0.3053 | 5.24 | 0.000 | |
| Seven | 1.0920 | 0.2693 | 4.06 | 0.000 | |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 1.3557 | 0.2723 | 4.98 | 0.000 | |
| 8AM to 12AM | 2.0402 | 0.3534 | 5.77 | 0.000 | |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 1.1176 | 0.2524 | 4.43 | 0.000 | |
| Door-to-door | 1.9997 | 0.3280 | 6.10 | 0.000 | |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 1.0067 | 0.2702 | 3.73 | 0.000 | |
| Free | 1.1908 | 0.2505 | 4.75 | 0.000 | |

Table 17. Conditional Logit Model Results - Polk County

| Variable | Coefficient | Standard Error | z | P > z | WTP (\$/Year) |
|--|-------------|----------------|-------|--------|---------------|
| Fee (\$/year) | -0.0583 | 0.0067 | -8.69 | 0.000 | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.5910 | 0.1394 | 4.24 | 0.000 | 10.14 |
| Seven | 0.5941 | 0.1401 | 4.24 | 0.000 | 10.20 |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 0.8210 | 0.1414 | 5.81 | 0.000 | 14.09 |
| 8AM to 12AM | 0.7383 | 0.1423 | 5.19 | 0.000 | 12.67 |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.2999 | 0.1421 | 2.11 | 0.035 | 5.15 |
| Door-to-door | 0.7543 | 0.1347 | 5.60 | 0.000 | 12.95 |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.8108 | 0.1414 | 5.73 | 0.000 | 13.92 |
| Free | 0.9420 | 0.1431 | 6.58 | 0.000 | 16.17 |
| Qualitative interaction variables | | | | | |
| Choose*Male | -0.7761 | 0.1867 | -4.16 | 0.000 | |
| Choose *White | -0.8046 | 0.3247 | -2.48 | 0.013 | |
| Choose *Single | -0.7190 | 0.3701 | -1.94 | 0.052 | |
| Choose *Income_2 | 0.5002 | 0.2801 | 1.79 | 0.074 | |
| Choose *Income_3 | -0.4744 | 0.2725 | -1.74 | 0.082 | |
| Choose *Income_4 | -0.5453 | 0.2825 | -1.93 | 0.054 | |
| Choose *College | 0.4260 | 0.2250 | 1.89 | 0.058 | |
| Choose*Only Far Children | -6.3065 | 2.0386 | -3.09 | 0.002 | |
| Choose*Only Far Children*Age | 0.1062 | 0.0315 | 3.38 | 0.001 | |
| Choose *City | 0.6895 | 0.2633 | 2.62 | 0.009 | |
| Choose *Voted | -0.2903 | 0.2900 | -1.00 | 0.317 | |
| Choose * Aware Public Transit | 0.4073 | 0.1951 | 2.09 | 0.037 | |
| Continuous interaction variables | | | | | |
| Choose *Age | -0.0030 | 0.0082 | -0.37 | 0.709 | |
| Choose *Old | 0.0004 | 0.0035 | 0.11 | 0.915 | |
| Choose *Country | -0.0098 | 0.0035 | -2.76 | 0.006 | |
| Choose *Transport | -0.0094 | 0.0033 | 2.89 | 0.004 | |
| Choose *Experience | -0.0532 | 0.0347 | -1.53 | 0.126 | |

Table 18. Mixed Logit Model Results - Polk County

| Variable | Coefficient | Standard Error | z | P > z | WTP (\$/Year) |
|--|-------------|----------------|-------|--------|---------------|
| Fee (\$/year) | -0.1179 | 0.0139 | -8.46 | 0.000 | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 0.7105 | 0.2592 | 2.74 | 0.006 | 6.02 |
| Seven | 0.7721 | 0.2592 | 2.97 | 0.003 | 6.55 |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | 0.9129 | 0.2665 | 3.43 | 0.001 | 7.74 |
| 8AM to 12AM | 1.0211 | 0.2661 | 3.84 | 0.000 | 8.66 |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 0.4215 | 0.2468 | 1.71 | 0.088 | 3.57 |
| Door-to-door | 1.2390 | 0.2589 | 4.79 | 0.000 | 10.50 |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 1.1860 | 0.2430 | 4.88 | 0.000 | 10.06 |
| Free | 1.5504 | 0.2777 | 5.58 | 0.000 | 13.14 |
| Qualitative interaction variables | | | | | |
| Choose*Male | -0.7706 | 0.3064 | -2.52 | 0.012 | |
| Choose *White | -1.0772 | 0.5144 | -2.09 | 0.036 | |
| Choose *Single | -0.5169 | 0.5843 | -0.88 | 0.376 | |
| Choose *Income_2 | 0.3475 | 0.4552 | 0.76 | 0.445 | |
| Choose *Income_3 | -0.5211 | 0.4523 | -1.15 | 0.249 | |
| Choose *Income_4 | -0.6490 | 0.4726 | -1.37 | 0.170 | |
| Choose *College | 0.4587 | 0.3685 | 1.24 | 0.213 | |
| Choose*Only Far Children | -4.7443 | 3.4005 | -1.40 | 0.163 | |
| Choose*Only Far Children*Age | 0.0842 | 0.0530 | 1.59 | 0.112 | |
| Choose *City | 0.3032 | 0.4053 | 0.75 | 0.454 | |
| Choose *Voted | 0.0711 | 0.4639 | 0.15 | 0.878 | |
| Choose * Aware Public Transit | 0.3610 | 0.3358 | 1.10 | 0.271 | |
| Continuous interaction variables | | | | | |
| Choose *Age | 0.0063 | 0.0131 | 0.48 | 0.632 | |
| Choose *Old | -0.0009 | 0.0058 | -0.16 | 0.871 | |
| Choose *Country | -0.0084 | 0.0056 | -1.51 | 0.131 | |
| Choose *Transport | 0.0059 | 0.0054 | 1.09 | 0.275 | |
| Choose *Experience | -0.0786 | 0.0560 | -1.40 | 0.161 | |

Table 18 continued

| Variable | Coefficient | Standard Error | z | P > z | WTP (\$/Year) |
|---|-------------|----------------|-------|--------|---------------|
| Standard Deviations of Variables with Random Coefficients | | | | | |
| Days of Operation Choice (Base = MWF) | | | | | |
| M-F | 1.5682 | 0.3985 | 3.94 | 0.000 | |
| Seven | 1.6173 | 0.3619 | 4.47 | 0.000 | |
| Hours of Operation Choice (Base = 7AM to 12PM) | | | | | |
| 7AM to 5PM | -1.5873 | 0.4290 | -3.93 | 0.000 | |
| 8AM to 12AM | 1.7908 | 0.4473 | 4.00 | 0.000 | |
| Type of Route Choice (Base = Fixed) | | | | | |
| Flexible | 1.5075 | 0.3648 | 4.13 | 0.001 | |
| Door-to-door | 1.5075 | 0.3648 | 4.13 | 0.000 | |
| Senior Citizen Discount Choice (Base = Full) | | | | | |
| Fifty | 0.9186 | 0.3995 | 2.30 | 0.021 | |
| Free | -1.6576 | 0.3082 | -5.38 | 0.000 | |

Table 19. Summary Statistics for Conditional and Mixed Logit Models - Atascosa and Polk Counties

| Summary Statistics | Conditional Logit | Mixed Logit |
|--------------------------------------|-------------------|-------------|
| Atascosa County | | |
| Number of Observations | 4065 | 4065 |
| Cluster (Number of Respondents) | 235 | 235 |
| McFadden's R^2 | 0.1213 | |
| Akaike Information Criterion (AIC) | 3938.791 | 2329.273 |
| Bayesian Information Criterion (BIC) | 4102.855 | 2543.819 |
| Percent Correct Predictions | 55.28% | 54.46% |
| Polk County | | |
| Number of Observations | 2752 | 2751 |
| Cluster (Number of Respondents) | 163 | 163 |
| McFadden's R^2 | 0.1232 | |
| Akaike Information Criterion (AIC) | 2669.761 | 1596.713 |
| Bayesian Information Criterion (BIC) | 2823.683 | 1797.983 |
| Percent Correct Predictions | 55.07% | 54.53% |

Table 20. Chi-Squared Hypothesis Tests - Atascosa and Polk Counties

| Hypothesis | $\chi^2 (1)$ | $P > \chi^2 $ |
|-------------------|--------------|----------------|
| Atascosa County | | |
| Conditional Logit | 0.59 | 0.4425 |
| | 0.78 | 0.3780 |
| | 25.69 | 0.0000 |
| | 8.91 | 0.0028 |
| Mixed Logit | 0.80 | 0.3723 |
| | 0.92 | 0.3380 |
| | 10.24 | 0.0014 |
| | 12.59 | 0.0004 |
| Polk County | | |
| Conditional Logit | 0.00 | 0.9815 |
| | 0.41 | 0.5222 |
| | 11.44 | 0.0007 |
| | 1.02 | 0.3136 |
| Mixed Logit | 0.05 | 0.8300 |
| | 0.14 | 0.7108 |
| | 8.93 | 0.0028 |
| | 1.98 | 0.1596 |

Table 21. Comparisons of the Conditional Logit Model WTP

| Transportation Attribute Level | Mean WTP | Standard Deviation |
|--------------------------------|----------|--------------------|
| M-F | | |
| Student | 13.45 | 2.53 |
| Atascosa County | 5.96 | 2.31 |
| Polk County | 10.14 | 2.63 |
| Seven | | |
| Student | 24.79 | 3.18 |
| Atascosa County | 7.65 | 2.35 |
| Polk County | 10.20 | 2.66 |
| 7AM-5PM | | |
| Student | 23.22 | 3.09 |
| Atascosa County | 13.01 | 2.56 |
| Polk County | 14.09 | 2.82 |
| 8AM-12AM | | |
| Student | 22.99 | 3.23 |
| Atascosa County | 14.89 | 2.83 |
| Polk County | 12.67 | 2.93 |
| Flexible | | |
| Student | 8.62 | 2.30 |
| Atascosa County | 3.43 | 2.32 |
| Polk County | 5.15 | 2.52 |
| Door-to-Door | | |
| Student | 13.17 | 2.54 |
| Atascosa County | 14.40 | 2.74 |
| Polk County | 12.95 | 2.81 |
| Fifty | | |
| Student | 18.07 | 2.83 |
| Atascosa County | 13.01 | 2.73 |
| Polk County | 13.92 | 3.01 |
| Free | | |
| Student | 22.67 | 3.13 |
| Atascosa County | 19.33 | 3.23 |
| Polk County | 16.17 | 3.22 |

Table 22. Wilcoxon-Mann-Whitney Rank-Sum Tests

| Null Hypothesis | z | P > z |
|---|---------|--------|
| M-F | | |
| Student sample = Atascosa County sample | -10.601 | 0.0000 |
| Student sample = Polk County sample | -9.037 | 0.0000 |
| Atascosa County sample = Polk County sample | -2.101 | 0.0357 |
| Seven | | |
| Student sample = Atascosa County sample | -17.746 | 0.0000 |
| Student sample = Polk County sample | -15.325 | 0.0000 |
| Atascosa County sample = Polk County sample | 0.783 | 0.4334 |
| 7AM-5PM | | |
| Student sample = Atascosa County sample | -13.705 | 0.0000 |
| Student sample = Polk County sample | -14.309 | 0.0000 |
| Atascosa County sample = Polk County sample | 3.449 | 0.0003 |
| 8AM-12AM | | |
| Student sample = Atascosa County sample | -8.251 | 0.0000 |
| Student sample = Polk County sample | -11.723 | 0.0000 |
| Atascosa County sample = Polk County sample | 3.629 | 0.0003 |
| Flexible | | |
| Student sample = Atascosa County sample | -9.271 | 0.0000 |
| Student sample = Polk County sample | -8.286 | 0.0000 |
| Atascosa County sample = Polk County sample | -0.257 | 0.7974 |
| Door-to-Door | | |
| Student sample = Atascosa County sample | -1.190 | 0.2342 |
| Student sample = Polk County sample | -2.899 | 0.0037 |
| Atascosa County sample = Polk County sample | 1.357 | 0.1748 |
| Fifty | | |
| Student sample = Atascosa County sample | -12.227 | 0.0000 |
| Student sample = Polk County sample | -12.691 | 0.0000 |
| Atascosa County sample = Polk County sample | 1.061 | 0.2885 |
| Free | | |
| Student sample = Atascosa County sample | -8.262 | 0.0000 |
| Student sample = Polk County sample | -11.584 | 0.0000 |
| Atascosa County sample = Polk County sample | 5.735 | 0.0000 |

APPENDIX B

FIGURES

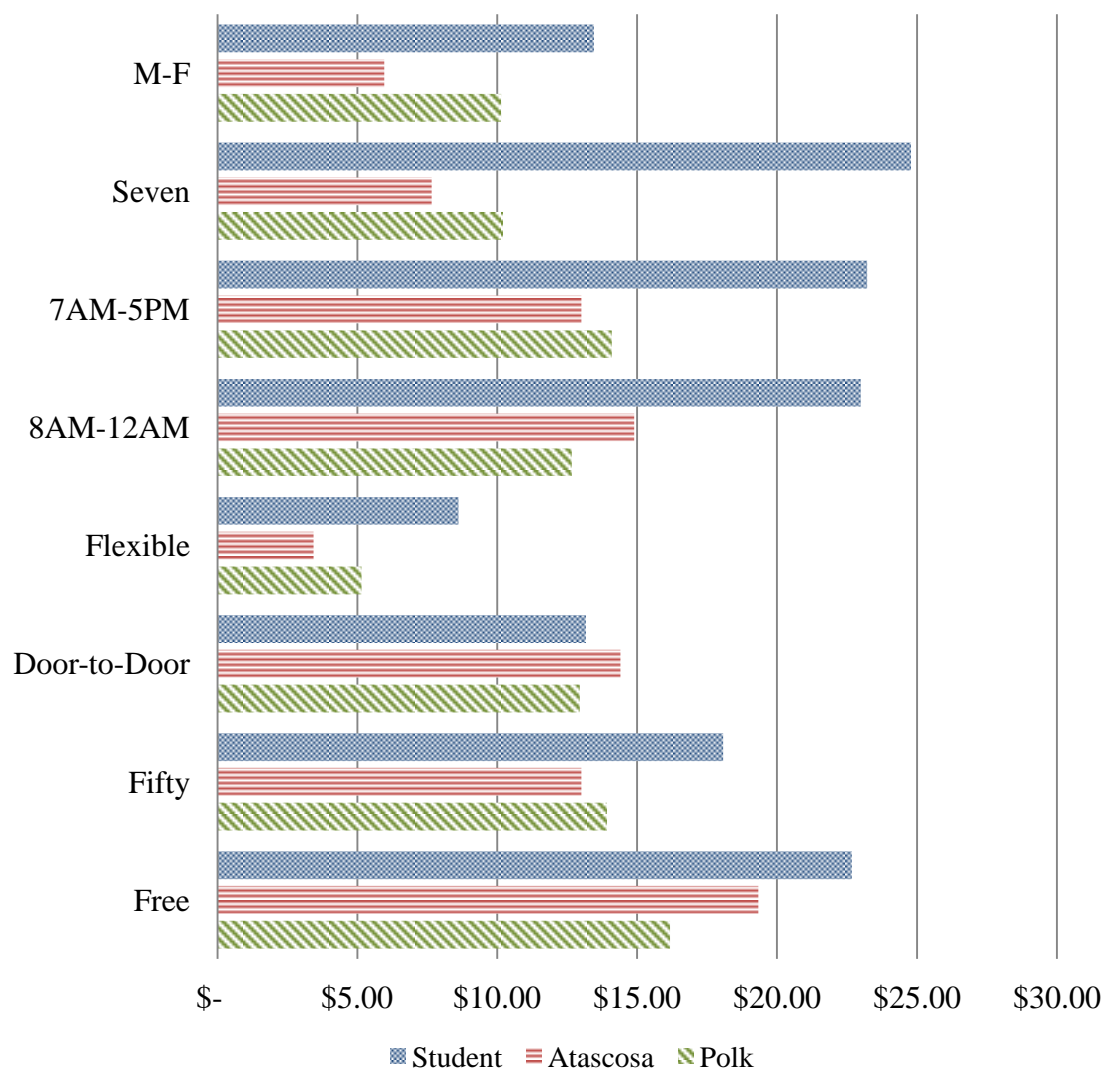


Figure 4. Conditional Logit Model Population Mean WTP for the Specified Transportation Attribute over the Base Level

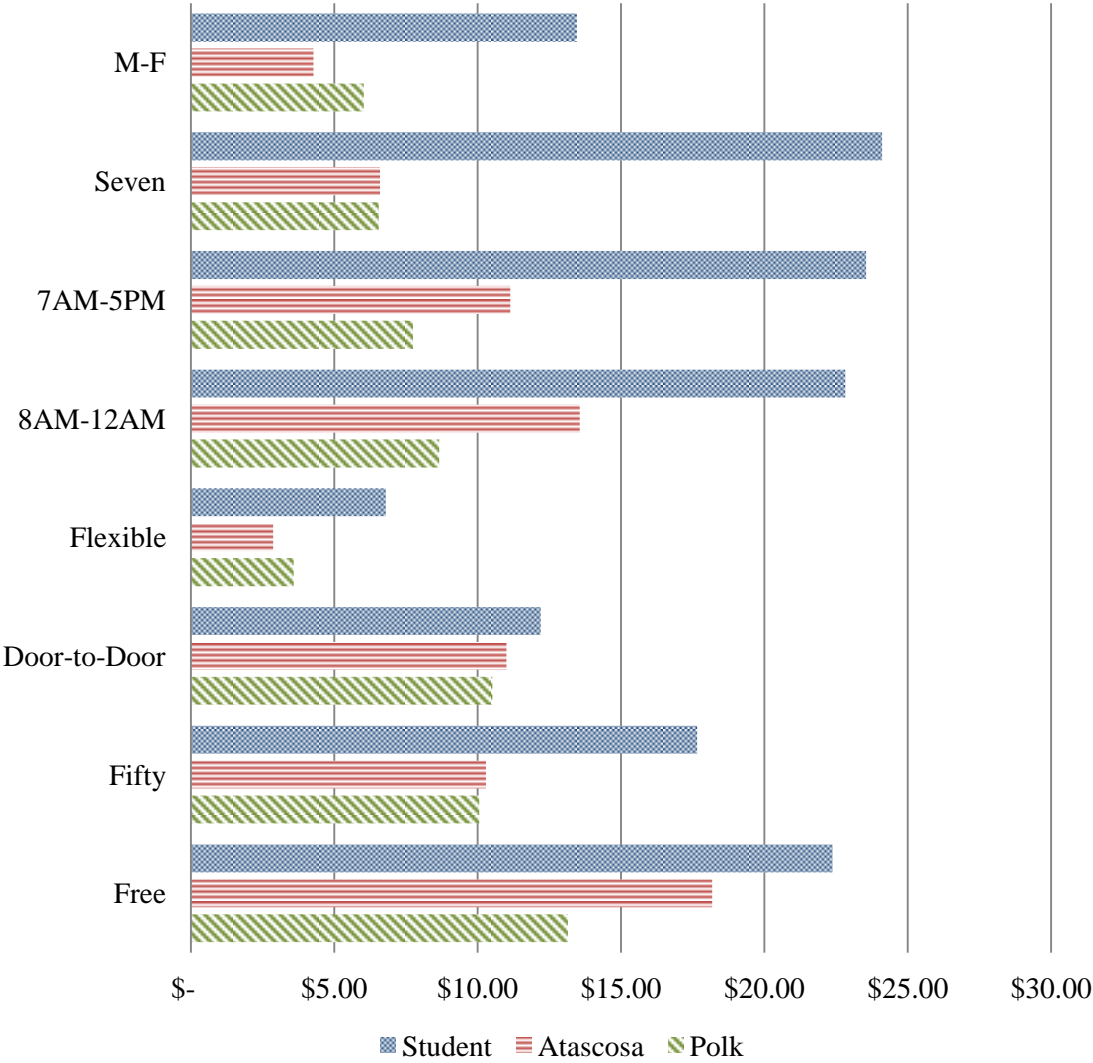


Figure 5. Mixed Logit Model Population Mean WTP for the Specified Transportation Attribute over the Base Level

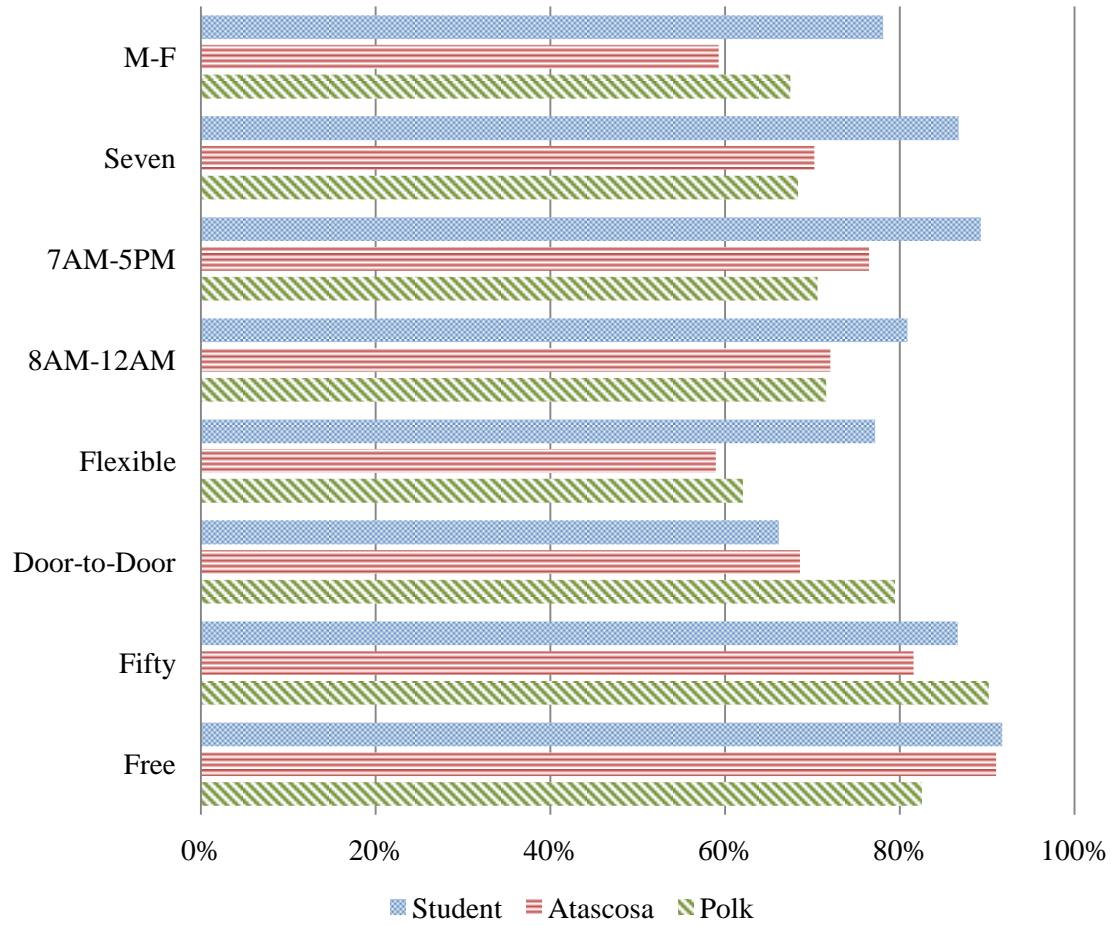


Figure 6. Mixed Logit Model Percent of Population with a Positive Willingness-to-Pay

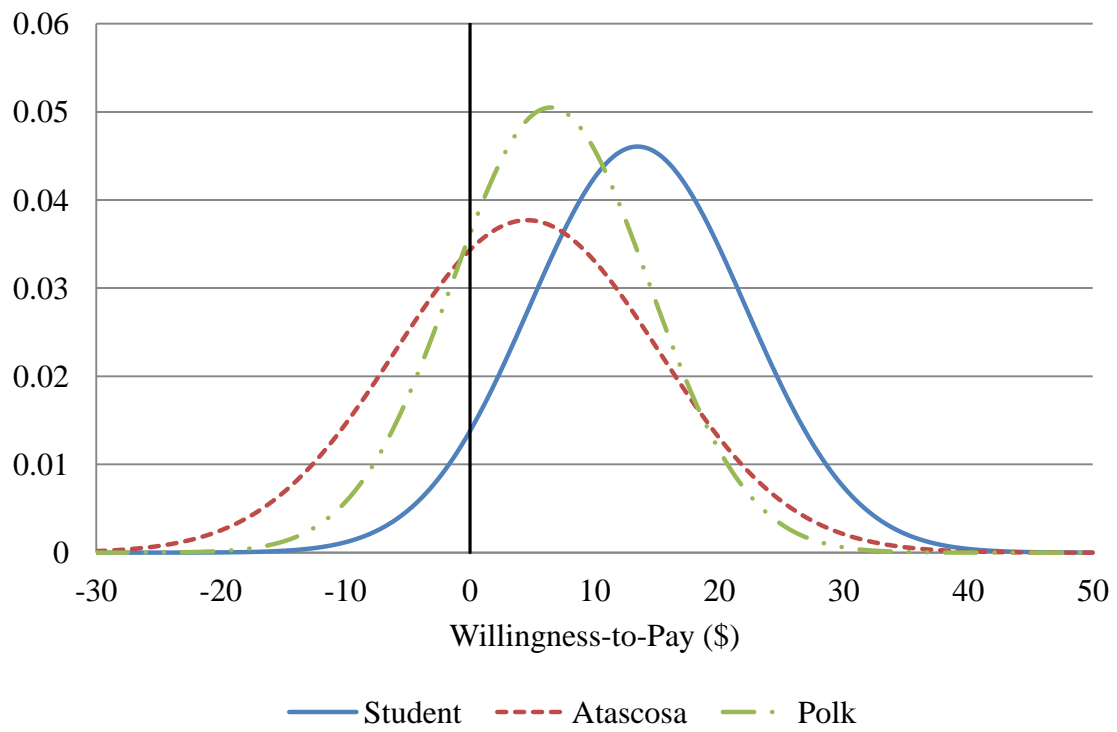


Figure 7. Mixed Logit Model Individual WTP Distribution – Monday-Friday

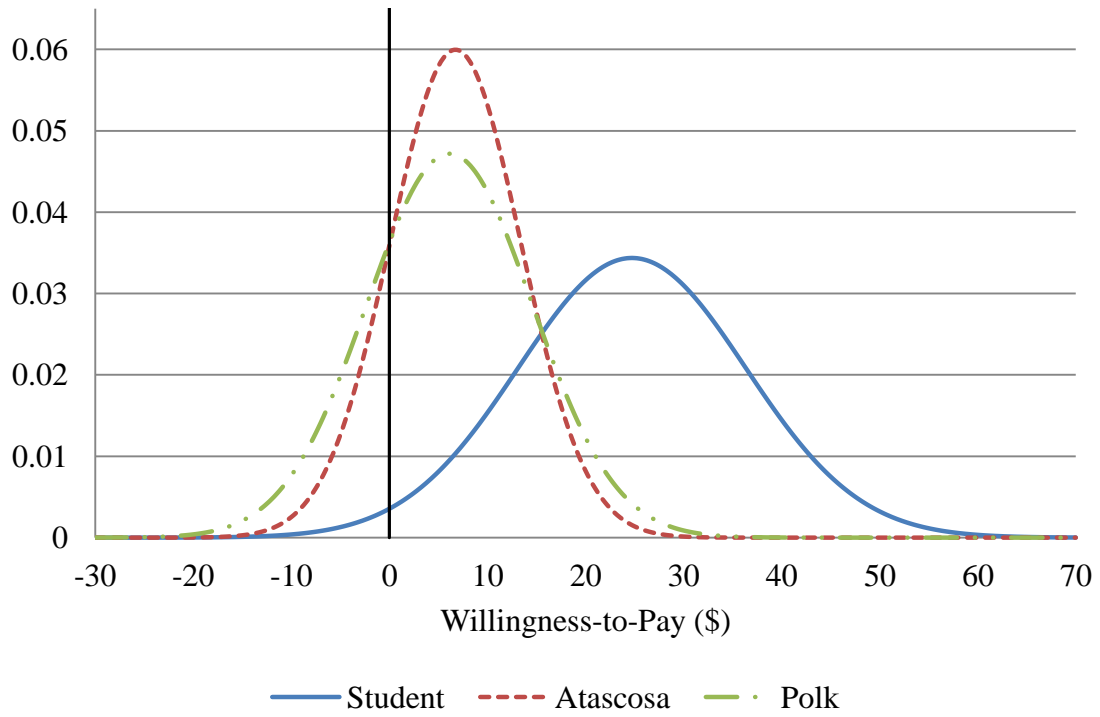


Figure 8. Mixed Logit Model Individual WTP Distribution – Seven Days a Week

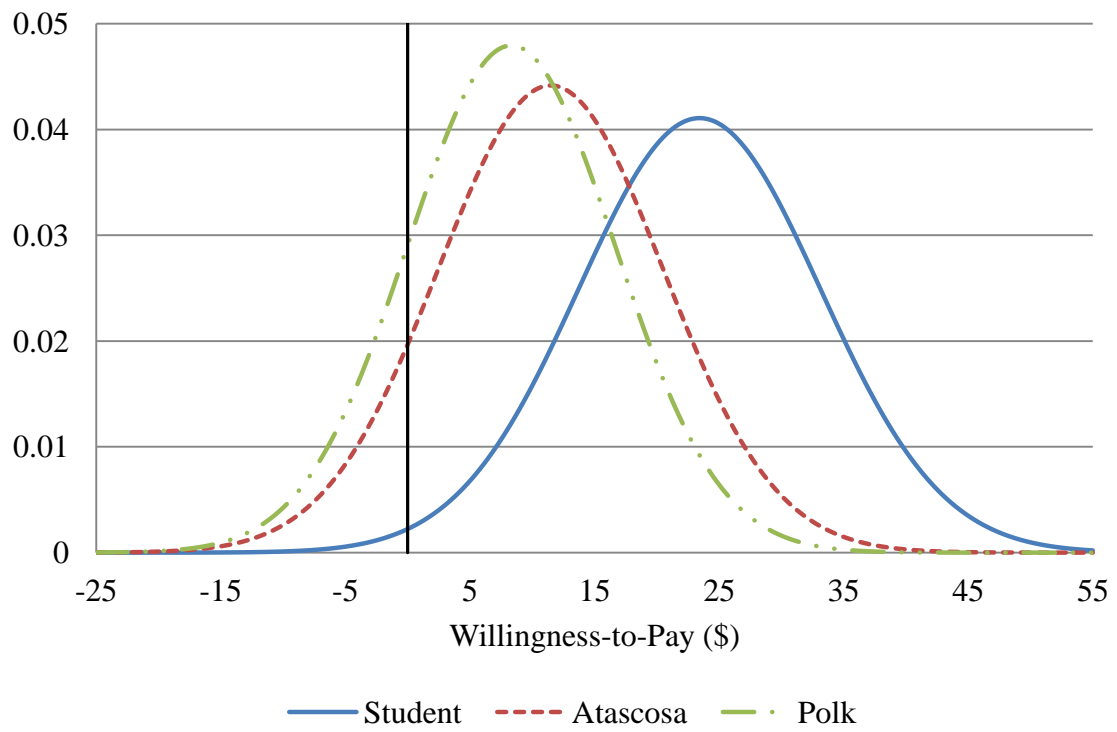


Figure 9. Mixed Logit Model Individual WTP Distribution – 7AM to 5PM

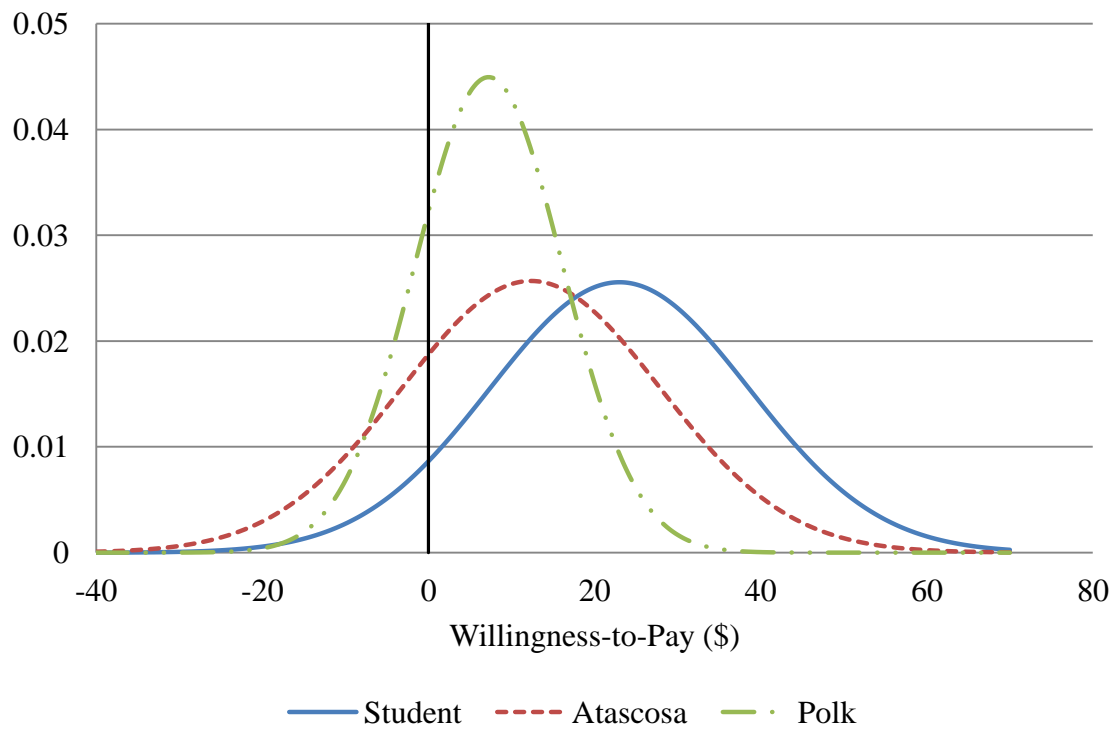


Figure 10. Mixed Logit Model Individual WTP Distribution – 8AM to 12AM

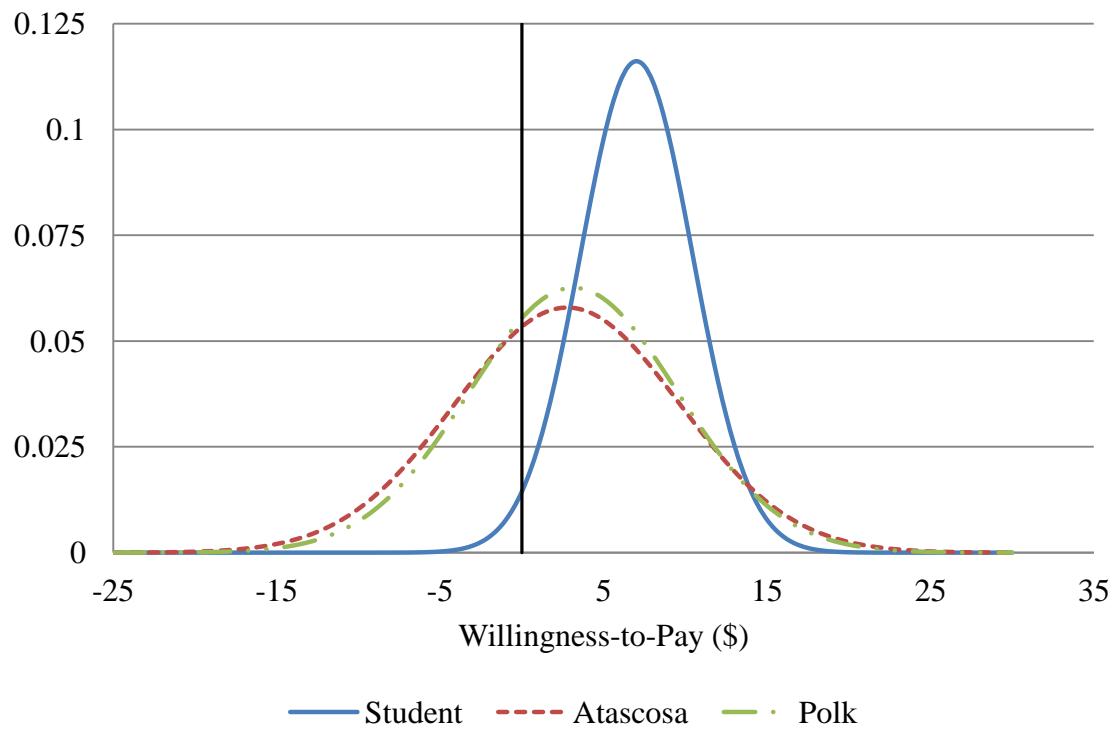


Figure 11. Mixed Logit Model Individual WTP Distribution – Flexible Route

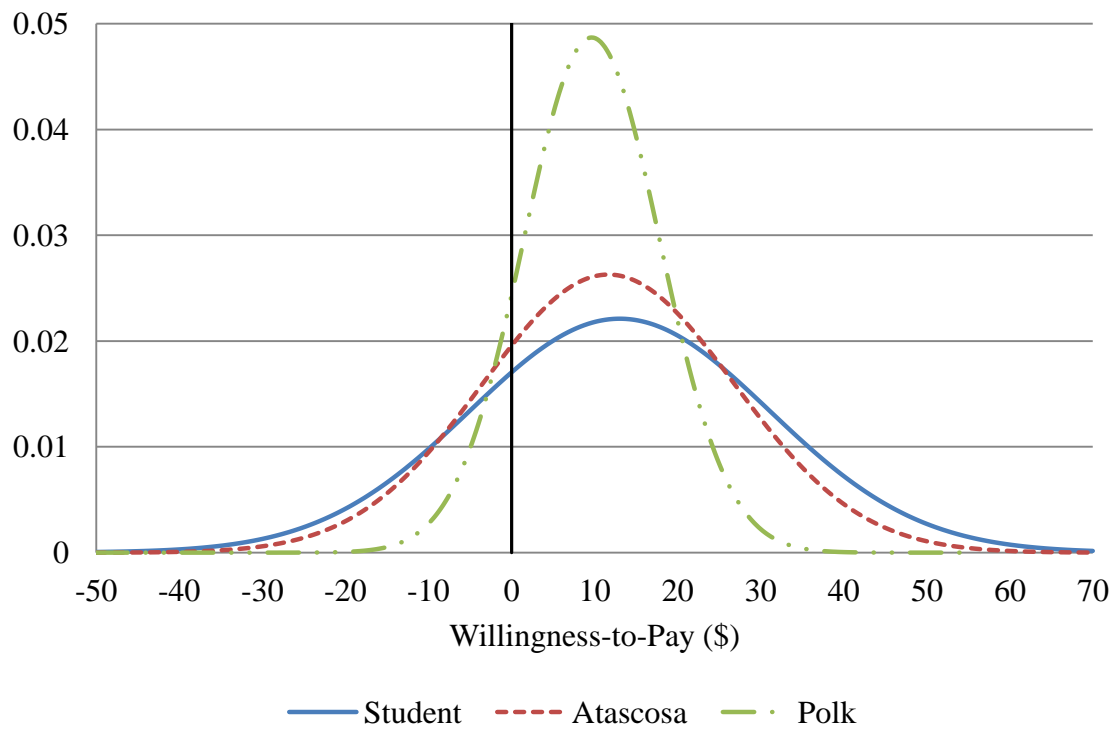


Figure 12. Mixed Logit Model Individual WTP Distribution – Door-to-Door Route

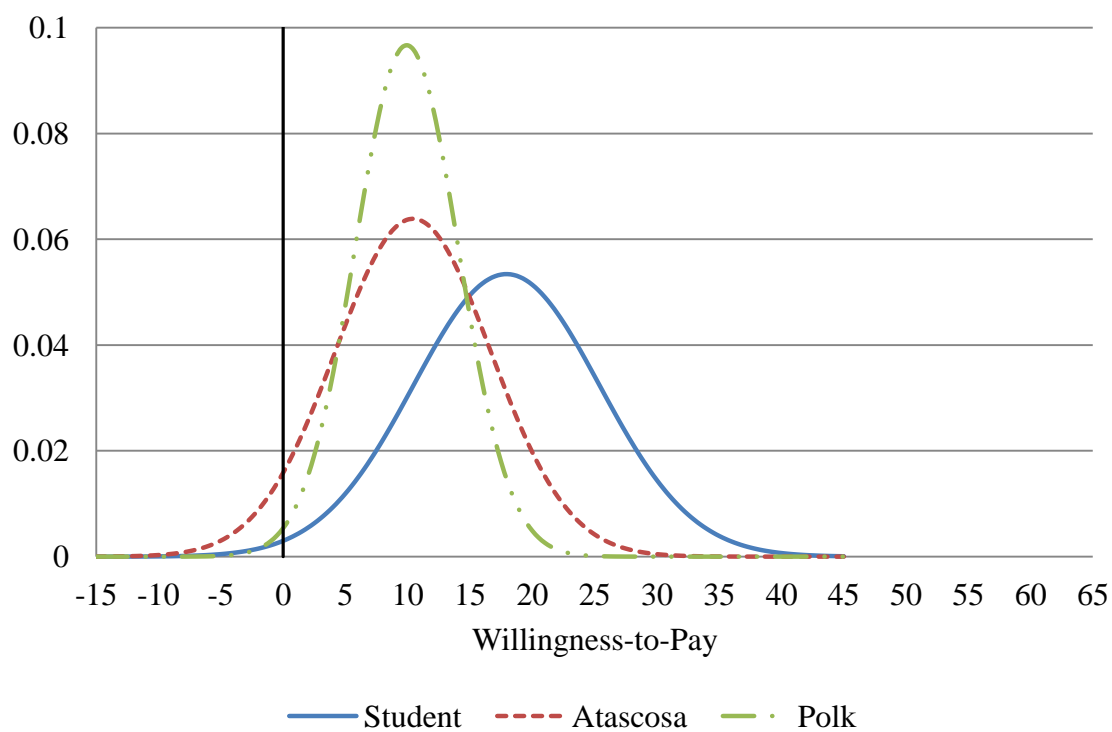


Figure 13. Mixed Logit Model Individual WTP Distribution – Fifty Percent Fare Discount

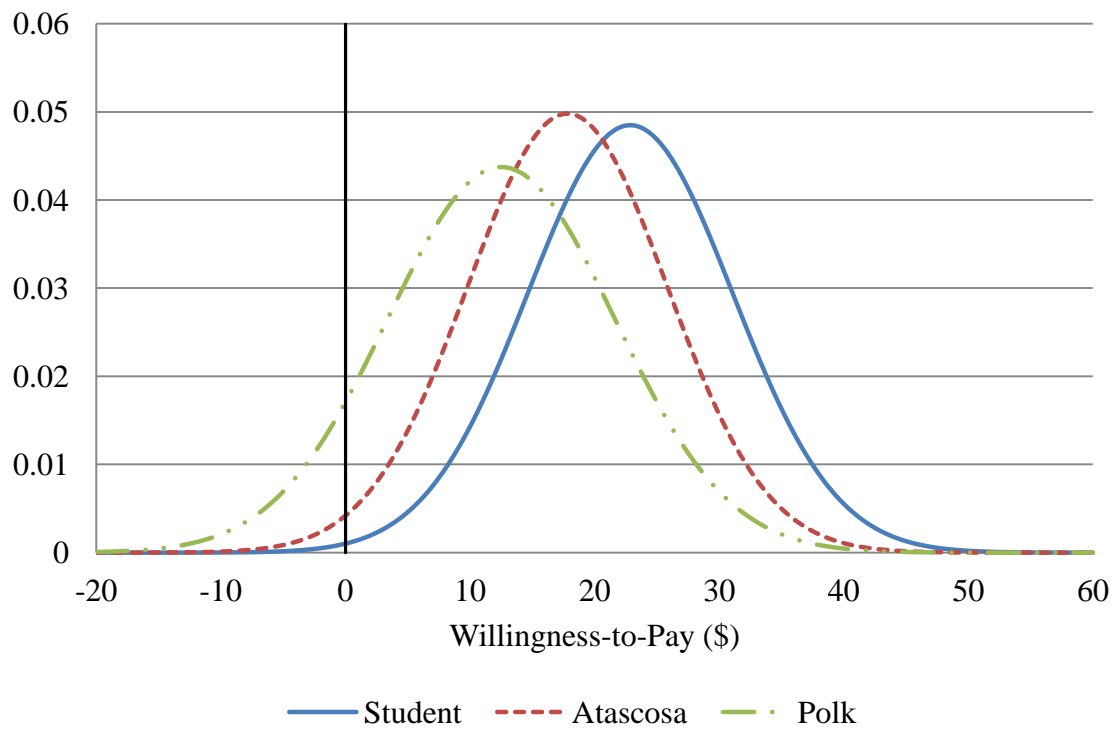
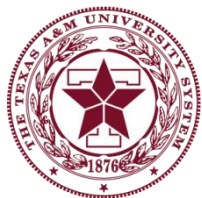


Figure 14. Mixed Logit Model Individual WTP Distribution – Full Fare Discount

APPENDIX C

STUDENT SURVEY



Natural Resource & Environmental Economics Working Group
Department of Agricultural Economics
Texas A&M University
College Station, TX 77843-2124

Dear Fellow Aggie,

You are receiving this survey to assist me in my Master of Science thesis research concerning transportation options for rural elderly Texans. It is important to understand how all ages of the public view the needs of the elderly.

Texas has the fourth largest elderly population in the country. In 2009, more senior citizens lived in rural areas than any other age group in Texas. This population is expected to continue to grow as baby boomers age and life expectancies increase. One central issue to the quality of life for rural senior citizens is their need for transportation options, specifically public transportation in their area.

Although it is popular in Texas for an individual to drive well into retirement, studies have shown that this is not always feasible or safe. Additionally, because of fixed, limited incomes, the elderly are not always able to afford a vehicle. If rural elderly individuals become unable to drive, there are few transportation options that provide the freedom and flexibility to make everyday trips such as running errands, social, and recreational outings, possibly leading to isolation and a decreased quality of life.

The objective of this study is to determine the value that the general public places on attributes of public transportation which support the quality of life for current and future rural elderly individuals. Your contribution is vital in providing policymakers and transportation authorities with accurate information. Thank you for your help.

Sincerely,

Alicia A. Israel
Class of 2010

Valuation and Opinions Concerning Transportation for the Rural Texas Elderly



Funded by the University Transportation Center for Mobility
Texas Transportation Institute
Texas A&M University System
College Station, TX

Participation in this survey is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University being affected. This study is anonymous and no identifiable information will be collected with your questionnaire.

If you have questions regarding this study, you may contact Alicia A. Israel at aisrael@agecon.tamu.edu

This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979)458-4067 or irb@tamu.edu.

Valuation and Opinions Concerning Transportation for the Rural Texas Elderly

1. What is your classification at Texas A&M University?
 - a. Freshman
 - b. Sophomore
 - c. Junior
 - d. Senior
 - e. Other (please specify) _____

2. What is your major? _____

3. What is your gender?
 - a. Male
 - b. Female

4. What is your age? _____ years

5. What is your race?
 - a. Caucasian/White
 - b. Black, African American
 - c. American Indian or Alaskan Native
 - d. Hispanic
 - e. Asian, Pacific Islander
 - f. Multiracial
 - g. Other (please specify) _____

6. What is your marital status?
 - a. Single
 - b. Married
 - c. Other (please specify) _____

7. What percentage of funding for your total annual living and college expenses come from the following sources: *The total of all percentages should equal 100%.*

| | |
|--|---------|
| Parents/Guardians | _____ % |
| Self-funded (through working, savings, etc.) | _____ % |
| Scholarships and Grants | _____ % |
| Military | _____ % |
| Loans | _____ % |
| Other | _____ % |
| Total | 100% |

8. What city/town do you consider to be your home town?

Please provide City/County/State/Zip code

9. How would you describe the area where your house in your home town is located?

- a. Inside city or town limits
- b. Outside city limits on a lot that is less than 5 acres
- c. Outside city limits on a lot that is 5 acres or greater
- d. On a working farm, or ranch
- e. Other (please specify) _____

10. Did you vote in the last national, state, or local elections? Please check all that apply.

☐ National
 ☐ State
 ☐ Local
 ☐ None

11. Are there options to use public transportation in your home town?

- ☐ As far as I know, there are no public transportation options in my home town.
Skip to question 13.
- ☐ Yes, there are public transportation options in my home town.
Continue to question 12.

12. How familiar are you with the following aspects of public transportation options in your home town?

| | | Not Familiar | | Neutral | | Very Familiar |
|----|---|-----------------|---|---------|---|------------------|
| a. | The type of public transportation options available in your community | 1 | 2 | 3 | 4 | 5 |
| b. | The service area for your community's public transportation options | 1 | 2 | 3 | 4 | 5 |
| c. | How to schedule a trip within the service area | 1 | 2 | 3 | 4 | 5 |
| d. | The fare for a one-way trip | 1 | 2 | 3 | 4 | 5 |
| e. | The availability of public transportation for residents who are senior citizens | 1 | 2 | 3 | 4 | 5 |

13. How important do you think it is for drivers of public transportation vehicles to have these additional types of training?

| | | Not Important | | Neutral | | Extremely Important |
|----|--|------------------|---|---------|---|------------------------|
| a. | Passing a background check | 1 | 2 | 3 | 4 | 5 |
| b. | Advanced first aid training | 1 | 2 | 3 | 4 | 5 |
| c. | Cardiopulmonary Resuscitation (CPR) training | 1 | 2 | 3 | 4 | 5 |

14. What do you feel is the percent chance (0 - 100%) that you will live to be 75, or older? _____%

15. What do you feel is the percent chance (0 - 100%) that you will live in a rural town or in the country (outside of city limits) when you are over the age of 75? _____%

16. What do you feel is the percent chance (0 - 100%) that when you are over the age of 75 you will use alternative forms of transportation like rides from family and friends, or using public or private transportation options (i.e. buses or taxis)? _____%

17. Based on your personal experiences, to what extent have age related disabilities affected the driving ability of the following people? In the scale, 1 indicates individuals have little to no difficulty driving whereas a 5 indicates their driving ability is limited to the point that they require assistance.

| | | Little to no difficulty | | Some difficulty | | Limited driving ability |
|----|---|----------------------------|---|--------------------|---|-------------------------------|
| a. | Elderly family members (including deceased) | 1 | 2 | 3 | 4 | 5 |
| b. | Elderly friends (including deceased) | 1 | 2 | 3 | 4 | 5 |

Transportation Preferences

To create public transportation options that benefit rural elderly Texans, it is proposed that a fee will be added to the annual registration costs of registering all Texas vehicles. This fee will be used to supplement local and state funds used for rural public transportation. Current fees paid when registering a passenger car / pickup in Brazos County are provided as a reference point.

| Fee Purpose | Annual Fee Amount (\$) |
|----------------------------|------------------------|
| License Fee | 40.80 - 50.80 |
| County Road and Bridge Fee | 10.00 |
| Child Safety Fee | 1.50 |
| DPS Fee | 1.00 |
| Large County Fee | 1.00 |
| Reflectorization Fee | 0.30 |

Use the following definitions when considering the different scenarios on the following pages.

| Attributes | Definition |
|---|--|
| Addition to Annual Registration Fee (\$) | The fee that would be added to the registration costs for all vehicles registered in the county. |
| Days of Operation | The days of the week that the public transportation option would be in operation. |
| Hours of Operation | The hours per day of operation the public transportation option would be available. |
| Type of Route | <p>The type of route that the public transportation option uses when it is in operation:</p> <p><u>Fixed Route Service</u>: Designated pick up and drop off locations at specific times each day according to a published schedule.</p> <p><u>Flexible Route Service</u>: Designated pick up and drop off locations at specific times each day according to a published schedule. However, with an advanced reservation passengers can request to be dropped off at a location within a prescribed distance from the scheduled route.</p> <p><u>Door-to-Door Service</u>: Curbside pick-up and drop-off at their origin and destination based on a reservation in advance.</p> |
| Senior Citizen Transportation Fare per Ride | The potential fare, per one-way trip, for those over 65 to use the public transportation option compared to the full fare. |

Currently, public transportation options in rural Texas are very limited and vary by county. There is a proposal to offer rural public transportation which will be the same in all aspects except for the ones listed. Given the following proposed public transportation options (Option A and Option B) please provide which one you prefer. If you do not prefer Option A or Option B, then choose Neither. Consider each of the following six scenarios independently.

Scenario 1. Please choose the option you prefer:

| | Option A | Option B | |
|--|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Scenario 2. Please choose the option you prefer:

Option A

Option B

Addition to Annual Registration Fee (\$)

Days of Operation

Hours of Operation

Type of Route

Senior Citizen Transportation Fare per Ride

I prefer (check one)

☐

Option A

☐

Option B

☐

Neither

Scenario 3. Please choose the option you prefer:

Option A

Option B

Addition to Annual Registration Fee (\$)

Days of Operation

Hours of Operation

Type of Route

Senior Citizen Transportation Fare per Ride

I prefer (check one)

☐

Option A

☐

Option B

☐

Neither

Scenario 4. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Scenario 5. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Scenario 6. Please choose the option you prefer:

Option A

Option B

Addition to Annual Registration Fee (\$)

Days of Operation

Hours of Operation

Type of Route

Senior Citizen Transportation Fare per Ride

I prefer (check one)

☐

Option A

☐

Option B

☐

Neither

Thank you for your participating in this survey.
Please return your completed questionnaire before leaving the classroom.

APPENDIX D

COUNTY RESIDENT SURVEY



Natural Resource & Environmental Economics Working Group
 Department of Agricultural Economics
 Texas A&M University
 College Station, TX 77843-2124

Dear County Resident,

You are receiving this questionnaire to assist county officials and researchers from Texas A&M University and the Texas Transportation Institute in examining issues relating to transportation options for rural, elderly Texans. The goal of this study is to understand how the general public views the transportation needs of this unique age group.

Texas has the fourth largest elderly population in the country. In 2009, more senior citizens lived in rural areas than any other age group in Texas. This population is expected to continue to grow as baby boomers age and life expectancies increase. One central issue to the quality of life for rural senior citizens is the need for transportation options, specifically public transportation, to make every day trips for running errands, attending social events, and participating in recreational outings.

Although it is popular in Texas for an individual to drive well into the years of retirement, studies have shown this is not always feasible or safe. Additionally, because of limited, fixed incomes, the elderly cannot always afford a vehicle. If rural, elderly individuals become unable to drive, they have few transportation options, possibly leading to isolation and a decreased quality of life.

The objective of this study is to determine the value that the general public places on attributes of public transportation for current and future rural, elderly individuals. Your contribution is vital in providing policymakers and transportation authorities with accurate information. Please fill out the enclosed questionnaire and return it using the provided pre-paid envelope. Thank you for your help.

Sincerely,

Alicia Israel
 Graduate Assistant, Texas A&M University

Dr. James Mjelde
 Professor, Texas A&M University

Dr. Rebekka Dudensing
 Professor and Extension Economist,
 Transportation Texas A&M University

Linda Cherrington
 Research Scientist, Texas
 Texas Transportation Institute

Valuation and Opinions Concerning Transportation for Texas' Rural Elderly



Funded by the University Transportation Center for Mobility
Texas Transportation Institute
The Texas A&M University System
College Station, Texas

Participation in this survey is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University or your county being affected. This study is anonymous, and no identifiable information will be collected.

If you have questions regarding this study, you may contact
Alicia Israel at (210) 473-4144 or aisrael@agecon.tamu.edu.

All individual responses will remain confidential. Only summary statistics will be reported. This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979) 458-4067 or irb@tamu.edu.

Valuation and Opinions Concerning Transportation for Texas' Rural Elderly

First, we invite you to provide us with information about yourself. This information helps us determine the characteristics of respondents in our survey sample.

12. What is your gender?
 - a. Male
 - b. Female

13. What is your marital status?
 - a. Single
 - b. Married
 - c. Separated or divorced
 - d. Widowed

14. What is your age? _____ years
If you are married, what is your spouse's age? _____ years

15. Please select the category that best fits your race/ethnicity.
 - a. Caucasian/white
 - b. Black, African American
 - c. Hispanic
 - d. Multiracial
 - e. Other (please specify) _____

16. What is the highest level of education you have completed?

- a. Less than 12th grade
- b. High school diploma or GED
- c. Some college, no degree
- d. Associate's degree
- e. Bachelor's degree
- f. Graduate and/or professional school

17. What is your before-tax household income?

- a. Less than \$10,000
- b. \$10,000 to \$24,999
- c. \$25,000 to \$49,999
- d. \$50,000 to \$74,999
- e. \$75,000 to \$99,999
- f. \$100,000 or more

18. How many of your children or dependents, excluding your spouse, live within each range of miles from your home? *Please leave blank if none.*

| Miles or Distance from Your Home | Number of Children or Dependents | |
|--|----------------------------------|-------------|
| | Under Age 18 | Over Age 18 |
| In your home, in the same dwelling | | |
| 1-50 miles, up to an hour of travel | | |
| 51-100 miles, more than one hour of travel | | |
| 101-500 miles, up to one day of travel | | |
| More than 501 miles, more than one day of travel | | |

19. In which town is the mailing address of your primary residence located?

Town: _____

20. How would you describe the area where your home is located?

- a. Inside town limits
- b. Outside town limits on a lot that is less than 5 acres
- c. Outside town limits on a lot that is 5 acres or more
- d. On a working farm or ranch
- e. Other (please specify) _____

21. Did you vote in the last national, state, or local elections? Please check all that apply.

☐ National
None

☐ State

☐ Local

☐

The next set of questions concerns the public transportation options provided by _____ to _____ County.

22. Are you aware of the public transportation provided by _____ to _____ residents?

☐ Yes. I am aware of _____.
Continue to question 12.

☐ No. I am not aware of _____.
Skip to question 13.

23. How informed are you with the following aspects of _____ transportation options in _____ County? **Only complete question 12 if you answered “Yes” to question 11.**

| | | Not Familiar | | Neutral | | Very Familiar |
|----|---|--------------|---|---------|---|---------------|
| | | 1 | 2 | 3 | 4 | 5 |
| a. | The types of public transportation services provided by _____. | 1 | 2 | 3 | 4 | 5 |
| b. | _____’s coverage area. | 1 | 2 | 3 | 4 | 5 |
| c. | How to schedule a trip with _____. | 1 | 2 | 3 | 4 | 5 |
| e. | The fare for a one-way trip using _____. | 1 | 2 | 3 | 4 | 5 |
| e. | The availability of public transportation that services senior citizens | 1 | 2 | 3 | 4 | 5 |

24. How important do you think it is for drivers of public transportation vehicles to:

| | | Not Important | | Neutral | | Extremely Important |
|----|---|---------------|---|---------|---|---------------------|
| | | 1 | 2 | 3 | 4 | 5 |
| a. | Have passed a background check | 1 | 2 | 3 | 4 | 5 |
| b. | Have advanced first aid training | 1 | 2 | 3 | 4 | 5 |
| c. | Have cardiopulmonary resuscitation (CPR) training | 1 | 2 | 3 | 4 | 5 |
| d. | Have disability equipment training | 1 | 2 | 3 | 4 | 5 |
| f. | Be multilingual | 1 | 2 | 3 | 4 | 5 |

25. Based on your personal experiences, to what extent have age-related disabilities affected the driving ability of the following people? On the scale, 1 indicates individuals have little to no difficulty driving, whereas 5 indicates individuals have limited driving ability, to the point that they require assistance.

| | | Little to no difficulty driving | | Some difficulty | | Limited driving ability |
|----|------------------------|--|---|--------------------|---|-------------------------------|
| a. | Elderly family members | 1 | 2 | 3 | 4 | 5 |
| b. | Elderly friends | 1 | 2 | 3 | 4 | 5 |

If you are over the age of 75, please skip questions 15-17.

26. What do you feel is the percent chance (0-100%) that you will live to be 75 or older? _____%
27. What do you feel is the percent chance (0-100%) that you will live, or continue living, in a rural town or in the country (outside of town limits) when you are over the age of 75? _____%
28. What do you feel is the percent chance (0-100%) that when you are over the age of 75, you will use alternative forms of transportation, such as rides from family and friends or public/private transportation options (i.e., buses or taxis)? _____%

Transportation Preferences

*Suppose for the purpose of this survey **only** that there will be an additional fee added to the annual cost of registering a vehicle to create public transportation options that benefit rural, elderly Texans. This fee will be used to supplement local and state funds used for rural public transportation within the county. **Please keep in mind that this is an entirely hypothetical exercise.***

Current fees paid when registering a passenger vehicle in _____ County are provided as a reference point when considering the proposed additional fee.

| Fee Purpose | Annual Fee Amount |
|-------------|-------------------|
| License Fee | \$50.75-\$54.00 |

Use the following definitions when considering the different scenarios on the following pages.

| Attributes | Definition |
|---|---|
| Addition to Annual Registration Fee (\$) | The additional fee that would be added to the annual registration costs for all passenger vehicles registered in Parker County. |
| Days of Operation | The days of the week that the public transportation option would be available. |
| Hours of Operation | The hours per day of operation the public transportation option would be available. |
| Type of Route | <p>The type of route that the public transportation option uses when it is in operation:</p> <p><u>Fixed-Route Service:</u> Designated pickup and drop-off locations at specific times each day according to a published route and schedule.</p> <p><u>Flexible-Route Service:</u> In addition to fixed-route services, passengers can request to be picked up or dropped off at a location within a prescribed distance (usually ¼ to ½ mile) from the scheduled route.</p> <p><u>Door-to-Door Service:</u> Curbside pickup and drop-off at a specific origin and destination based on an advance reservation.</p> |
| Senior Citizen Transportation Fare per Ride | The potential discount compared to the full fare, per one-way trip, for those over 65 to use the public transportation option. The amount of the full fare is not a consideration. |

Suppose, for the purpose of this survey only, there will be an additional fee added to the annual cost of registering a vehicle in Parker County to fund public transportation to fit the needs of the county's residents. In each of the following six choice scenarios, the proposed public transportation options A and B are the same except for the characteristics listed. Please answer which one you prefer, Option A, Option B, or neither.

Please choose Option A, B, or Neither for each of the independent scenarios presented.

Scenario 1. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Please choose Option A, B, or Neither for each of the independent scenarios presented.

Scenario 2. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Please choose Option A, B, or Neither for each of the independent scenarios presented.

Scenario 3. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Please choose Option A, B, or Neither for each of the independent scenarios presented.

Scenario 4. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Please choose Option A, B, or Neither for each of the independent scenarios presented.

Scenario 5. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Please choose Option A, B, or Neither for each of the independent scenarios presented.

Scenario 6. Please choose the option you prefer:

| | Option A | Option B | |
|---|--------------------------------------|--------------------------------------|-------------------------------------|
| Addition to Annual Registration Fee (\$) | | | |
| Days of Operation | | | |
| Hours of Operation | | | |
| Type of Route | | | |
| Senior Citizen Transportation Fare per Ride | | | |
| I prefer (check one) | <input type="checkbox"/> Option A | <input type="checkbox"/> Option B | <input type="checkbox"/> Neither |

Please provide us with any comment(s) you have pertaining to this survey or the issue of providing transportation for the rural elderly.

**Thank you for participating in this survey.
Please return your completed questionnaire in the provided pre-paid return envelope.**

VITA

Name: Alicia Ann Israel

Address: Texas A&M Department of Agricultural Economics
TAMU 2124
College Station, TX 77845-2124

Email Address: aisrael2010@gmail.com

Education: B.S, Applied Mathematics, Texas A&M University, 2010
M.S., Agricultural Economics, Texas A&M University, 2012

Work Experience: Agrilogic Insurance Services, Assistant Research Analyst
August 2011 to Present
Texas A&M University, UTCM Graduate Research Assistant
January 2011 to May 2012
The National Association of Manufacturers, International
Economic Affairs / U.S. Commerce Department Intern
May 2010 to August 2010
Texas A&M University, UBM Undergraduate Research Assistant
January 2009 to May 2010

Presentations: Israel, A., J.W. Mjelde, R. Dudensing, L. Cherrington, Y. Jin, and
J. Chen. 2012. "The Value of Transportation for Improving
the Quality of Life for the Rural Elderly." Paper presented at
the Southern Agricultural Economics Association Annual
Meetings, Birmingham, AL February 4-7.
Israel, A., and S. Herbrich. 2009. "Hempstead Superfund
Site: Statistical Analysis of Contamination Factors." Presented
at Texas A&M University Student Research Week
Competition. College Station, TX March 24-28. Awarded 1st
place – Hydrology/Water Resources/ Environmental Studies
Category.

Honors and Awards: Dept. of Agricultural Economics Regents Fellow (Fall 2010)
Charles E. Gilliland Scholarship (Fall 2010)
Lechner Fellowship (2006-2010)
J. Malon Southerland Aggie Leadership Scholarship (2007-2010)
Texas A&M Honors Dept. University Scholar (2007-2010)
Pi Mu Epsilon Mathematics Honors Society Member (2008-2010)
Phi Beta Kappa Honors Society Member (2009-2010)